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1955

THE LOWER PALAEOLITHIC SITE OF MARKKLEEBERG AND OTHER COMPARABLE LOCALITIES NEAR LEIPZIG

RUDOLF GRAHMANN

Former State Geologist for Saxony on the German Geological Survey

Edited by CALLAM L. MOVIUS, JR.

Curator of Palaeolithic Archaeology, Peabody Museum, Harvard University

THE AMERICAN PHILOSOPHICAL SOCIETY

INDEPENDENCE SQUARE

PHILADELPHIA 6

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DECEMBER, 1955

To the memory of my Son
Rudolf

Born in Leipzig, November 19, 1924,
whose young life was sacrificed
November 20, 1943

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EDITOR'S PREFACE

In January, 1950, Dr. Rudolf Grahmann wrote to me concerning the possibility of printing this monograph in the United States. Since it was virtually impossible to publish such a work under post-war conditions in Germany, he decided to send the manuscript together with all the illustrative material to me in the spring of that year. After reading the text I was convinced that it constituted a very important contribution to our knowledge of the Lower Palaeolithic of Central and Western Europe, and accordingly I recommended to Dr. J. O. Brew, Director of the Peabody Museum of Harvard University, that the necessary funds be appropriated to cover the cost of having it translated into English. Dr. Brew approved this project in the fall of 1950, and the original German text was turned over to Miss Maria von Mering, Secretary of the Anthropology Department of Harvard University, who completed the first draft of the English translation in the spring of 1951.

In his letter accompanying the manuscript Dr. Grahmann wrote: "I feel sure that you will encounter many difficulties with the translation, since my German text was written without ever supposing that it would be published in another language." Throughout I have endeavored to the best of my ability to make sure that Dr. Grahmann's thoughts were expressed correctly in English. It should be pointed out, however, that this has involved a great deal more than a straightforward translation of his German text. For instance, the descriptive terminology used with reference to flint artifacts and glacial geology has been altered in accordance with nomenclature commonly employed in the English and American literature. In some cases Dr. Grahmann's conclusions were stated in more positive terms than seemed warranted by the evidence set forth in the text, and I have made minor alterations in accordance with my best judgment. But no changes in the factual material as such have been made. Furthermore, it should be emphasized that, although I disagree with the author on certain points, I have made a conscious effort not to inject any of my own opinions in the text. Of course only Dr. Grahmann himself can judge to what extent, if any, I have unintentionally modified his meaning, or weakened or overemphasized his argument. To have noted all such changes in terminology and shadings of interpretation as seemed advisable would have entailed appending a running commentary of considerable length, and this would have contributed very little to the primary purpose of the work.

One of the reasons why it has required so many months to prepare the English edition of this monograph is because it was necessary to remount all the line-cuts showing the archaeological material. Of course this necessitated changing all the references to them in the text, as well as a complete reorganization of the descriptions of each of the illustrated artifacts. This very painstaking and laborious assignment was most ably carried out by Mr. Robert H. Dyson, Jr., Junior Fellow of Harvard University, and I should like to take this opportunity to thank Mr. Dyson for his invaluable assistance. For generous financial support which has made possible the completion of this project, I am grateful to the George Grant MacCurdy Fund of the Peabody Museum of Harvard University, the Bollingen Foundation, Inc., of New York, and the Department of Anthropology of Harvard University.

In conclusion it should be stated that nearly all the archaeological material from Markkleeberg and other Lower Palaeolithic sites in the Leipzig region was lost during World War II. Hence this report, together with Dr. Grahmann's excellent drawings of a selected series of the specimens, has an added importance. Furthermore, Leipzig is now in the Russian Zone of Germany, and Dr. Grahmann cannot return there to continue his work. Regardless of the present political situation, however, the author should derive a great deal of satisfaction from the very fact of his achievement: this monograph is a basic and fundamental contribution to the archaeological literature. Indeed it is one of the very few monographic studies ever produced dealing with a single Lower Palaeolithic site in Europe. I close this preface with a deep sense of responsibility. Because of the nature of the task I have performed, I must share the responsibility for any errors or shortcomings that may be revealed, but to Dr. Grahmann alone belongs the credit for having produced an outstanding important addition to the field of Palaeolithic archaeology.

HALLAM L. MOVIUS, JR.

Peabody Museum,
Harvard University,
Cambridge, Mass., U.S.A..
April 6, 1954

AUTHOR'S PREFACE

The entire manuscript of this monograph, together with the original plates, was lost during the occupation of Brünn (Moravia) in April, 1945, while it was in the hands of a publisher. A second version was then accepted in the summer of 1947 by a West German publisher, but post-war political and economic difficulties prevented this from being printed.

Early in 1950 Professor Hallam L. Movius, Jr., Curator of Palaeolithic Archaeology in the Peabody Museum of Harvard University, learned of my dilemma, and he requested me to submit to him the German text of my Markkleeberg report. After examining it, he wrote asking my consent to publish the monograph in English in the United States. I accepted this very generous offer with the greatest pleasure, and in June, 1950, the complete manuscript was sent to him, together with the accompanying illustrations. At that time neither of us had any idea what a difficult undertaking this was to be; consequently the preparation of the English translation has taken far longer than was originally anticipated. Indeed, during the last three years I have come to appreciate the magnitude of the work accomplished by Professor Movius. In completing this project he has applied himself in a most generous and whole-hearted manner, with perfect understanding of the problems involved, the highest sense of objectivity, and in the friendliest spirit. It is a great privilege for me to take this opportunity to express to him my heartiest and most sincerely felt thanks. I wish to thank also all those who assisted him in this difficult work, as well as those who provided the financial support that made possible the preparation of the English text. Certainly Professor Movius merits the profound gratitude of all our colleagues who, as the result of his labors, now have access to my monograph in the English language.

RUDOLF GRAHMANN

Coblenz, Rhineland,
January 31, 1954

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RUDOLF GRAHMANN

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INTRODUCTION

The Lower Palaeolithic site of Markkleeberg, near Leipzig, was discovered in 1895. Therefore, it is one of the oldest of its kind known in Germany and still is one of the richest. In 1914 Dr. K. H. Jacob-Friesen, the prehistorian, and Dr. C. Gäbert, the geologist, studied this site and published the first monograph on it, at that time the only one dealing with the Lower Palaeolithic of Germany. These prehistoric investigations demonstrated how difficult it was to classify the material in terms of the French archaeological system as it was known at that time. It was recognized that the age classification thus determined did not agree with the dating based on the geological method. As a result, the Markkleeberg site became the focal point of all considerations of the Old Stone Age in Germany, a situation which has remained unchanged until the present time.

Forty years have passed since then. Meanwhile, research on both the Old Stone Age and the Pleistocene Ice Age has made considerable progress. Primarily H. Breuil has departed from traditional concepts in France, the classic country for Palaeolithic research, by broadening the archaeological system and fitting it better into the structure of the Ice Age. The Pleistocene deposits in Central and North Germany were definitely dated and correlated with the sequence of Alpine glaciations worked out by Penck and Brückner (1902). Meanwhile, the quantity of material found at Markkleeberg had greatly increased, thereby providing the basis for a better evaluation. Thus a new study of the Markkleeberg site appeared necessary. With this end in view, the writer first attempted to assemble together all artifacts from the site, since many professionals and amateurs had collected at Markkleeberg for several decades. It was possible to find a total of 2,686 perfect specimens in public and private collections. In addition to Markkleeberg, Lower Palaeolithic artifacts from the same geologic horizon were collected in several neigh-

boring fields, and more than 450 of these specimens have been traced. In so far as they aid in the examination of the problem as a whole, they and the sites where they were found will be referred to in the present monograph.

A grand total of 3,152 artifacts was available for this work. This amount may seem small in comparison with materials from Middle or Upper Palaeolithic occupation sites, and certainly it is much smaller than the number of pieces found at such Lower Palaeolithic sites in France as those in the Somme River valley. In Central Europe, however, the material from Markkleeberg is unique both with respect to age and quantity.

The artifacts from all collections were placed at my disposal for documentation and study, and I would like to express my sincere thanks to Otto Karl, Rudolf Moschkau and Franz Schulte of Leipzig who have helped me in every possible way. For the perusal of other collections in Germany, as well as for comparative studies in France, Belgium and England, which I completed in 1938, I was generously supported by the "Deutsche Forschungsgemeinschaft" for which I am deeply indebted.

I could only devote myself to the study of the material on a part-time basis. Among other difficulties my efforts were hindered by the fact that it was impossible to have the entire collection together simultaneously. In addition to these general problems came the constant threat of air attacks in 1944. This necessitated the repeated safe-guarding of the irreplaceable material, of the drawings and of the manuscript, and made it impossible to consult the necessary works of reference. For this reason the original plan of discussing the importance of the material in terms of the European Palaeolithic as a whole had to be abandoned. Therefore, this work is primarily limited to a critical study of the collections of archaeological material from Markkleeberg and vicinity. The section dealing with the geology of the site was written in 1942. The preparation of the archaeological section, including the writing up of the individual descriptions of the illustrated artifacts, was accomplished in the year 1944.

HISTORY AND SIGNIFICANCE OF MARKKLEEBERG

The following study is entirely based on the accumulation of available facts, and for this reason a critique of the very extensive writings regarding Markkleeberg will be omitted. Braune (1928) has summarized all views hitherto expressed dealing with the archaeological and geological significance of the site, and hence only an outline of the history of the discovery and its basic interpretations will be given here.

The former village of Markkleeberg[1] is located 8 km. south of the center of Leipzig on the gently escarped eastern slope of the flat valley of the Pleisse River (*see* figs. 1 and 8), which has only slightly cut into the local Pleistocene and Tertiary sediments. The older gravel deposits of this Elster tributary are now being removed at a series of sand and gravel pits, and it is at these commercial excavations that the artifacts are found. The first ones were discovered in 1895 by Etzold, a Leipzig geologist, who published nothing concerning his finds until many years later, but kept their origin a secret. He managed to amass a considerable collection, but did not describe the story of how he discovered the site until 1918, after it had become known to other collectors. Jacob-Friesen (with Gäbert, 1914) had already briefly outlined the later history of the site, and he makes the following statement:

> Shortly after the turn of the century, when the Eolithic problem was of primary interest to many workers, Hugo Obermaier of Vienna asked the Leipzig Museum of Ethnology to permit him to collect flint chips from river gravels which showed traces of rolling, and could be used as proof that the "eoliths" could develop in a natural manner and did not necessarily trace back to human activity.

Jacob-Friesen, then only a high-school boy, had collected among other things two flint chips in a gravel pit at Markkleeberg (*Mc* in fig. 8), which he considered to be eoliths. These supposed eoliths were sent to Obermaier, who recognized them as genuine palaeoliths. He wrote: "The objects are heavily patinated and of Lower Palaeolithic character, strongly reminiscent of Cergy, Saint Acheul, Chelles and Montières in France." Jacob-Friesen continued to collect in the pit, which subsequently had been expanded (fig. 8, p. 525), as well as at *Me*. When a sufficient number of flawless implements had been collected, he presented them to the Leipzig friends of primitive history at a meeting of the Society for Ethnology on January 19, 1912. Etzold, the geologist, also appeared at this meeting; he displayed a beautiful flint point and stated that he had been collecting palaeoliths in a gravel pit situated north of the road which led from Markkleeberg to Wachau (*M* in fig. 8) since 1895. Unfortunately, Etzold refused Jacob-Friesen's offer to publish jointly the finds from Markkleeberg.

In 1914, after Jacob-Friesen's first reports in 1911 and 1913, the aforementioned monograph by him and Gäbert appeared. Under the influence of Breuil, Commont, and Obermaier, to whom the collections were shown, Jacob-Friesen recognized three stages on the basis of technique and state of preservation, the oldest of which he classified as Upper Acheulian or Lower Mousterian, and the youngest as Developed or Final Mousterian with suggestions of Aurignacian. Gäbert came to the conclusion, however, that the Pleisse

[1] In 1934 the village of Markkleeberg was united with a number of places west of the Pleisse River, a tributary of the Elster, to form the municipality of Markkleeberg and is now called "Markkleeberg-Ost." The archaeological site can be reached from Leipzig by streetcar, line 24; it is located 500 meters south of the last stop (compare fig. 8, p. 525).

gravels were to be assigned to the second half or to the end of the next to last North German Interglacial. Accordingly, the implements were all considerably older than the French Mousterian, which dates from the end of the 3rd Interglacial and the beginning of the Würm or 4th Glaciation. Thus, a dispute regarding the archaeological and geological age determination of the site arose.

After the Markkleeberg localities became known through these publications, many more specimens were collected during the following three decades, often with the help of the sand-pit workers. Many of the pieces got into the hands of those who collect simply for the purpose of collecting something, so that they were not accessible for scientific study, and hence were totally lost for that purpose. Furthermore, many of the less experienced collectors amassed flint pieces from the Markkleeberg pits which were not worked at all, but, because of their accidental form and supposed trimming, were easily mistaken for genuine artifacts. Such pseudo-artifacts are sometimes found in certain collections, and in some cases they have even been published and unfortunately described as typical Markkleeberg forms, especially in the evaluation of the industry with finds from other sites. In the last decade almost all of the newly-discovered genuine or supposedly genuine Lower Palaeolithic sites in Germany have been compared with Markkleeberg. There can hardly be any doubt that many "prehistorians" who refer to Markkleeberg have not seen a single *bona fide* artifact from there; sometimes one may even doubt whether the very characteristic illustrations in Jacob-Friesen's monograph were known to them.

The discovery and first investigations of the Markkleeberg site came at a time when knowledge of the Palaeolithic (especially the Lower Palaeolithic) was almost entirely based on the finds in France. Here the extended system of de Mortillet was in its heyday, and it was quite natural that an effort was also made to arrange the finds in other countries according to this system. The integration of this system into Penck and Brückner's (1902) subdivisions of the Ice Age was still uncertain and disputed. But it is likewise true that the stratification of the Pleistocene deposits near Leipzig was not known in all details. Therefore, it is understandable that different opinions were expressed concerning the archaeological classification and the geologic age of the Markkleeberg finds. In part this resulted from short visits to the Markkleeberg pits, and in part from our neglect to observe the exact horizon of the finds. Now from a geological point of view, it has always been maintained that the implement-bearing Markkleeberg gravels are older than the maximum of the 2nd Glaciation of the Leipzig region, which was generally considered to be the next to last glaciation of Northern Germany, and accordingly was correlated with the Saale Stage of the North European sequence. Differences arose only because some geologists assigned the gravel to the next to last interglacial or toward its end, while others placed it in the next to last glacial episode. But this was only a matter of small differences of opinion.

The archaeological classification of the material by the prehistorians was very much more uncertain. In addition to Acheulian and Mousterian, a Chellian and even a Micoquian age was attributed to the Markkleeberg assemblages, apparently with complete disregard for the significance of this last mentioned stage of culture. Furthermore, the geological age of the Acheulian and Mousterian stages in France was still uncertain, and it was only a result of the influence of Obermaier and Boule that the Acheulian was finally placed in the Last Interglacial while the Mousterian was assigned to the end of the latter and to the beginning of the Würm Glaciation. Schmidt (1913) made essentially the same division. Thus, the Markkleeberg finds could be arranged, on the basis of whatever cultural stage one saw in them: either in the Last Interglacial or in the beginning of the Würm, which contradicts the geological conclusions. Wiegers (1920), who placed the "Chellian" and the Lower Acheulian stages in the Mindel-Riss Interglacial, and the Upper Acheulian in the Riss, has assigned the Markkleeberg finds to the Acheulian on the basis of the above scheme, contradicting many archaeologists.

Thus, there was considerable disagreement between the geological and archaeological age determination to which Jacob-Friesen (1914: 104 ff.) had already referred. Braune later presented this contradiction as a problem in two reports which included all the geological and archaeological data. More recently Andree (1939) has arranged the Markkleeberg finds in their proper geologic context, but his archaeological interpretation is not tenable. The choice of the samples illustrated by him, some of which are apparently not even worked, is not adequate to convey a picture of this rich site.

After the archaeological system of de Mortillet was expanded, mainly owing to the efforts of Breuil, and an arrangement of the stages into the glacial sequence was proposed which was in better agreement with the geological facts based on the Central European Palaeolithic finds, there were no further contradictions in the archaeological interpretation and the geological age determination of the Markkleeberg site. Since it has been proved that the geological evidence supports and augments the archaeological system, this terminates the so-called "problem" of the site. As a result, the scientific importance of Markkleeberg has increased rather than decreased. Indeed an extremely fertile field for research is now open because of the firmly established geological structure for dating the archaeological material. New findings will hardly conform to the concepts which were valid at the time of the original discoveries and early studies, but for this very

reason the sites hold the key to the historical development of the Lower Palaeolithic, of the Middle Palaeolithic, and perhaps even of the Upper Palaeolithic.

This singular position of the Markkleeberg finds all the more justifies renewal of their study, because many fine specimens scattered in different collections have not yet been considered. At the same time, the samples of other sites in the vicinity of Leipzig should also be taken into consideration. These samples had been discovered by zealous collectors under the same basic geological conditions.

GEOLOGY

1. STRATIFICATION OF THE PLEISTOCENE DEPOSITS NEAR LEIPZIG

The survey of the Pleistocene deposits in Central Germany made after the First World War proved with certainty that three ice ages were represented (Grahmann, 1925). These correspond with the three stages distinguished in Northern Germany, which, according to the classification of the former Prussian Geological Institute, are designated as the Elster, Saale, and Weichsel Stages. As long as it was not clear which episodes of the Alpine glacial system established by Penck and Brückner (1902) correspond with the North German ones, this special nomenclature was justified. But, on the basis of paleontological, morphological, and stratigraphic investigations of river terraces, one may now consider it fairly certain that the three North German stages correspond with the last three major Alpine episodes. Accordingly, it seems advisable for our purposes to employ the alpine terminology which is now used outside the Alpine region. Therefore, in this monograph we will use the terms Mindel Glaciation, Riss Glaciation, and Würm Glaciation to designate these events (compare fig. 1).

As a result of the effect of the cold climate of each glacial episode, the forests of the Leipzig region disappeared completely. In the lowlands cold steppe and tundra conditions prevailed, and the uplands were totally bare. The land, deprived of its protective floral cover, was exposed to the destructive effects of frost. The rocks were subjected to strong mechanical weathering, and large accumulations of talus and structure soils covered the summits and slopes of the uplands. Melt- and rain-waters, as well as periglacial solifluction, moved the debris of weathering toward valley bottoms in such quantity that the rivers, frozen solid for a large part of the year, were unable to carry away their loads. Stream incision was thereby interrupted, and the valley bottoms were gradually filled up with sand and gravel. In the periglacial climate of each of three glaciations, aggradation of the stream valleys occurred. When the deepening of the valleys began again during the warm interglacial intervals, the gravel deposits laid down during times of glacial maximum were dissected so that today they appear as terraces on the valley slopes.

In the vicinity of Leipzig the Pleistocene river gravels[1] are up to 6 to 15 m. thick. The continental ice from the north gradually moved southward up the local valleys, damming the northward-flowing streams to form pro-glacial lakes, which were also fed by melt-water from the continental ice itself. The lake basin in each valley was filled to that height at which discharge over a divide to the west, or through the crevasse system of the ice itself, became possible (Grahmann, 1937). In these dammed-up bodies of water fine sands and clays were laid down over the gravel, which, because of the alternating content of the glacial waters during the summer and winter seasons, reveal clearly defined laminae that differ markedly with respect to the size of the grain constituents. These are referred to as annually layered (laminated) glacial lake clays, or varved clays. These pro-glacial lakes, formed between the ice front and the ascending valley floor, were literally pushed southward by the advancing ice-sheet, in effect uphill, across the unctuous lacustrine clays. For the latter acted as a grease-like medium over which the continental ice, now unburdened by the lake water, could slide southward. Thus the glacial lake clays are overlain by the ground moraine, which in turn is capped here and there by deposits of melt-water sands and gravels.

Under such geographical conditions, the Scandinavian and Baltic erratics, which the ice brought in its moraine, could not be transported into the upland region to the south by either the glacial waters or the rivers, and therefore could not become mixed with the gravels of the rivers which flow from the south. For this reason, all river gravels laid down prior to the arrival of the first inland ice (i.e., all gravels older than the beginning of the Mindel Glaciation) contain only constituents of native stones and are completely free of northern erratics.

The glacial advance during the Mindel Stage in Germany was by far the most extensive. The outermost limit of the ice lay at least 70 km. south of Leipzig, and the oldest ground moraine was spread out just as far (compare fig. 1). Invariably the ice covered the Mindel glacial river gravels with a layer of varved clays 50 cm. to 1.00 m. thick. Since the latter is particularly well-developed in the Leipzig area, and since its stratigraphic position was first recognized there, it is called Leipzig Varve Clay (Grahmann, 1925). In Northwestern Saxony the Mindel moraine locally attains a thickness of up to 45 meters. With the Mindel morainic debris a considerable quantity of erratics of northern origin arrived in the region, the Scandinavian and Baltic origin of which makes it possible to determine the time of arrival and direction of flow of the ice. During the summer melting season,

[1] In this work the term *gravel* denotes fluvial deposits in their totality without regard to granularity, including fine gravel, sand, and silt.

the sands and gravels of the glacial waters were spread out over the ground moraines in various places, these latter, of course, also containing northern erratics.

In the lower courses of the rivers flowing from the south, the local bedrock was now mantled with Mindel moraine with its countless erratics of northern derivation. Therefore, all deposits of fluvial origin in the Leipzig region that are younger than the first glaciation of the area, in addition to the native rock constituents, contain northern erratics which were derived from the erosion of the older moraine. Since the latter was very strongly eroded during the Mindel-Riss Interglacial, northern erratics are frequently found in the river gravels laid down at the beginning of the Riss Glaciation as well as that of the Würm Stage. Thus on the basis of the rock constituents, the gravels of Mindel age can be distinguished from the fluvial deposits of the two younger glacial stages. Furthermore, the Riss and Würm gravels may be distinguished on the basis of their relative stratigraphic position, their state of preservation and the characteristics of their covering layers, i.e., morainic deposits, loess, or both.

During the Riss Glaciation, the northern ice-sheets again penetrated the Leipzig lowland basin and advanced southward to a line 30 km. beyond Markkleeberg. The gravels of the Riss glacial rivers, which contain many flints and other erratics from the eroded Mindel moraines, are only occasionally overlain by varved clay, which at most is only a few decimeters thick and is called Böhlener Varve Clay. Overlying the latter is the Riss moraine, which is only a few meters thick south of Leipzig. In place of varved clay and ground moraine, sand and gravel mixed with northern erratics have been laid down directly on the river gravels at scattered localities where the glacial melt-waters flowed beneath the ice. The melt-water sands and gravels which form numerous low mounds and hills, as well as a few morainic ridges, east, north, and west of Leipzig, originated during a temporary halt subsequent to the maximum of the Riss Glaciation.

During the Würm Glaciation, the Scandinavian ice did not cross the Elbe, but in the Leipzig area a true glacial climate prevailed and aggradation again occurred in the valleys. The Würmian fluvial deposits naturally contain flints and other erratics of northern origin derived from the moraine of the two older glaciations, as well as from the re-deposited Riss glacial outwash. Also during Würm times the cap of the North European ice attained a height of more than 2,000 meters in the area of the northern Baltic (Grahmann, 1937). The cooling effect of this high, extensive mass of ice created a condensation of the air masses above it. Hence anti-cyclonic autumn winds blew to the south and southwest, and swept fine sands and dust out of the melt-water and other fluvial deposits, transporting this material southward until it was laid down as loess at the base of the uplands. Here it

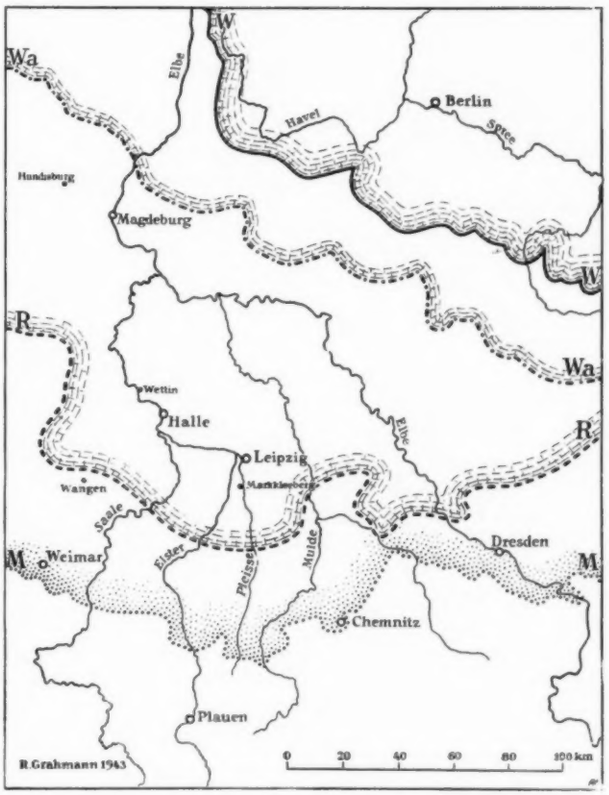


FIG. 1. The outermost limits of the northern ice-sheets in Central Germany. M = Mindel; R = Riss; Wa = Warthe Stage of the Riss Glaciation; W = Würm.

was caught by low bushes and shrubs of willow and birch which broke the transporting power of the wind and prevented the falling dust from being more widely distributed (Grahmann, 1939). The northern edge of the zone of thick genuine loess deposits lies 25 km. south of Leipzig. To the north of the true loess zone, there are aeolian deposits, but they do not attain a thickness of more than 1 meter and represent a mixture of drifted sand and loessic dust. This can be described as sandy loess. The sandy loess is as old as the true loess, of which it is a facies, and shares the characteristic that the underlying boulders and cobbles (the residuals from previous erosion) show clear evidence of wind abrasion and not uncommonly have the form of ventifacts. The deposition of loess and sandy loess was initiated at the time of the accumulation of the Würm river gravels, of which the lower terraces are built (compare Grahmann, 1932).

Separating these three stages of glacial deposition are the interglacials—intervals of alteration and of degradation and down-cutting. The glacial formations sometimes fell victim to these processes, and especially after the Mindel Glaciation there followed a time of extremely effective degradation and leveling. Only under favorable conditions did the older moraine for-

TABLE 1

	Pebble Contents	Preservation	Covering Layers
Würm Glaciation	Native and northern	Fresh	Lacking
Riss Glaciation	Native and northern	Weathered	Moraine and loess
Mindel Glaciation	Only native	Weathered	Moraine (at times from two ice advances) and loess

mations escape this degradation. Thus the Riss moraines often lie immediately over Pre-Pleistocene beds, from which may be inferred a long duration of the Mindel-Riss Interglacial. During the Last Interglacial the degradation is less impressive. Nevertheless, the Riss ground moraines, except for a few of the larger boulders, were often completely swept away. These boulders then formed a stone or block pavement and were in part wind-polished during the last ice advance. Owing to the strong degradation during the interglacial stages, no aggradations referable to these intervals developed in our district.

On the basis of the foregoing description, the Pleistocene sequence in the vicinity of Leipzig can be summarized as follows:

Würm Glaciation	Stream gravels with cobbles of local and northern derivation (Lower Terrace). Loess and sandy loess.
Third Interglacial	Degradation and deepening of valleys.
Riss Glaciation	Outwash sand and gravel. Moraine. Local Böhlener Varved Clays. Stream gravels with cobbles of local and northern derivation.
Second Interglacial	Strong degradation; levelling, deepening, and widening of valleys.
Mindel Glaciation	Outwash sand and gravel. Moraine (rich in Baltic and Scandinavian erratics). Leipzig Varved Clays. Stream gravels with cobbles of exclusively local derivation.

The two older glaciations show the same complete sedimentary cycles, yet their fluvial gravels are sharply distinguished by the fact that northern cobbles first appear in the Riss gravels. The Riss and Würm river gravels have the same constituents, but their weathering characteristics are different. The formations of the Würm Glaciation are always fresh and light-colored, whereas those of the Riss are usually weathered, brown, and sometimes even appear loamy. Furthermore, they carry a moraine, or at least traces of one, and above there is Würm loess or sandy loess. The gravel of the Würm reveals no weathering horizon, save for a covering of young alluvial loam or sand.

These characteristics of the river gravel, which are most important for establishing the Pleistocene sequence in the Leipzig region, are set forth in table 1.

The characteristics of each are diagnostic and, in fact, an incorrect identification of a stream gravel is impossible if the overlying beds are preserved. Of course this is not always the case. In some instances, they are more or less eroded, at many exposures down to a mere remnant of boulders and cobbles, which were originally contained in the moraine. In that case, however, the position of the gravel in the terrace profile, that is to say, its altitude above the flood plain, generally clearly shows its stratigraphic position.

The gravel terrace of the Würm Glaciation in the Leipzig region is only 0 to 2 meters above the broad Post-Glacial flood plain, and often it is described as the Low Terrace (compare figs. 5 and 7). Owing to being covered by ground moraines and in the south by loess, the older terraces are often nearly obliterated. But their position has become known through numerous borings for lignite (Grahmann, 1925). For these gravels the terms Middle and High Terraces have been used. It has been discovered that in the Leipzig district the High (Mindel) Terrace has a steeper declivity than the younger ones, so that it crosses the younger terraces in the axial section. Hence the Mindel Terrace is the highest in the uppermost section of the Elster and the Pleisse Valleys; but near Leipzig, for example, the High Terrace lies *beneath* the Riss Terrace. For this reason expressions which allude to the height of the older terraces are omitted, for they can be easily misunderstood.

The morphological survey of the valleys in the Leipzig region have shown still another more-or-less well developed terrace, which is younger than the one of Riss age, but which is still older than the Low (Würm) Terrace. It is covered only by loess. In the broad valley near Leipzig, the surface of this terrace is just as high as that of the Riss terrace, so that the two features may be easily confused. At first it was thought that the younger, loess-covered terrace represented an independent gravel formation, which is younger than the Riss formations but older than the Würm complex. Further investigations showed, however, that this terrace represents only a degradational stage, and that it was cut out of the older formations. Therefore, it cannot be used for purposes of determining the age of the aggradations. Probably it represents the Warthe stage of the Riss Glaciation.

2. THE GRAVELS OF THE RISS GLACIATION NEAR LEIPZIG

Since the Riss glacial river gravels in the Leipzig region contain Palaeolithic implements, they will be discussed in detail in order to establish their precise geo-

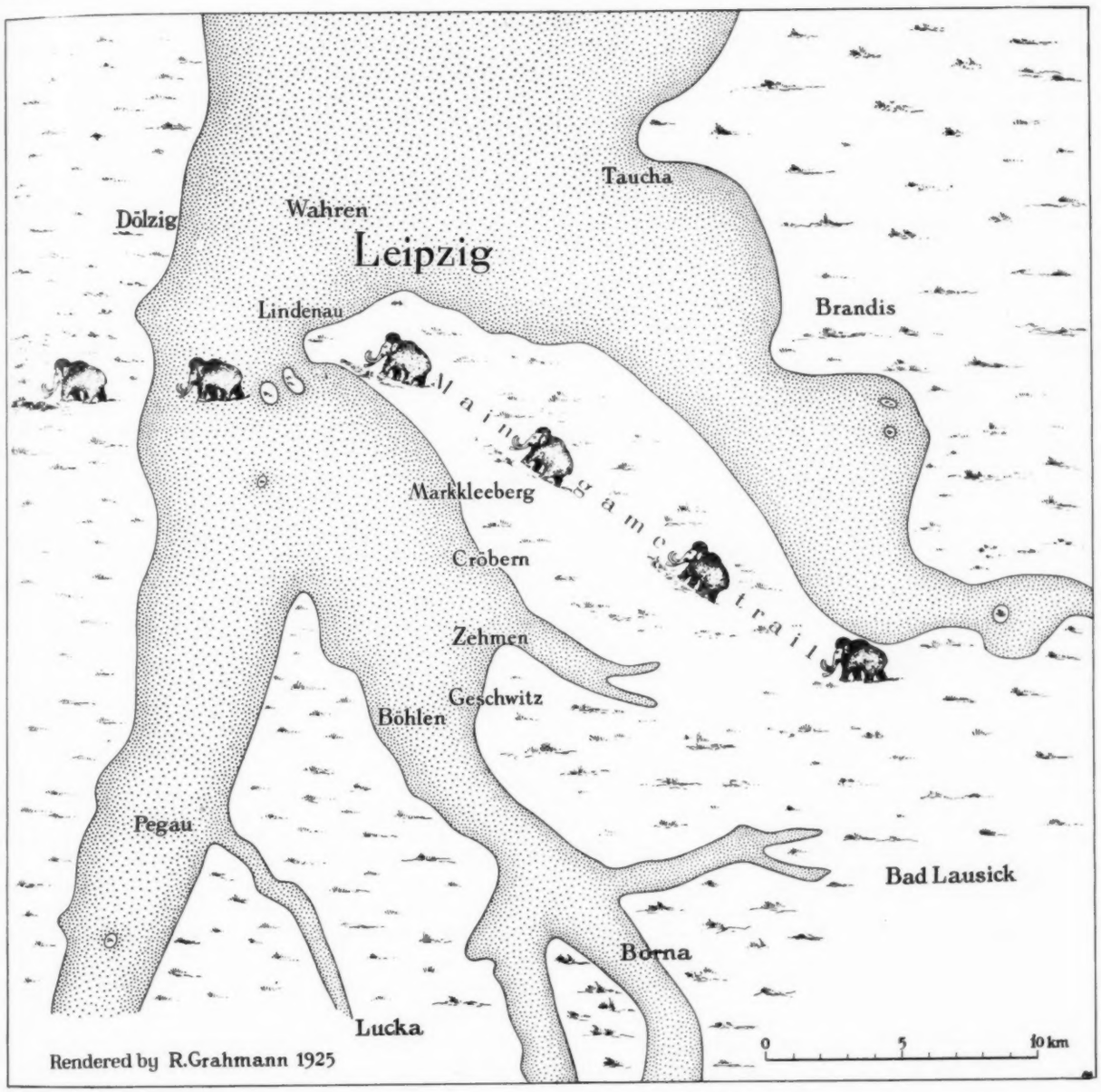


FIG. 2. Distribution of the Riss glacial gravels in the vicinity of Leipzig.

logical age. On the basis of their pebble constituents, these were deposited by the Mulde, Pleisse, and Elster rivers.

Until the onset of the Riss Glaciation, the Mulde (fig. 4, p. 521) flowed from Grimma across Naunhof to Leipzig and there joined the Elster in the northern part of the city. South of the city was the confluence of the latter with the Pleisse. The combined Elster-Mulde flowed northward in the direction of Bitterfeld. Under the damming action of the Riss ice and its moraines, the Elster was later diverted westward toward the Saale, and the Mulde was diverted toward Wurzen into an already existing river valley. Riss gravels are extensively developed near Leipzig, as shown on the map (fig. 2). However, they are mostly buried beneath ground moraine and sandy loess deposits and appear only on the valley slopes. Here, therefore, many sand and gravel pits may be found.

The Elster gravels of Riss age occur principally to the west of the present Elster flood plain, and usually form there a well-defined terrace. The gravel averages 6 to 8 m. thick, but occasionally is up to 12 m. Practically everywhere it is overlain by moraine of Riss age, and in the south by Würm loess as well. It rests in

part on Oligocene formations, and in part on the moraine of Mindel age. Large erratic boulders of northern origin derived from the Mindel deposits are almost always to be found in the lower part of the gravel. The basal portion of this gravel is generally coarse, becoming finer toward the upper level. Even-bedded sand layers occur at the top. West of Leipzig this gravel terrace has a slope of 1 : 900; its surface lies at an elevation of 117 m.; and north of Leipzig it is at + 109 m. The width of the terrace ranges from 5 to 8 km. west of Leipzig.

To the west and southwest of Leipzig, the Elster gravel is exposed in many pits mostly beneath a 1- to 2-meter thick cover of ground moraine. The best exposure was formed in the large basin which was dredged for the Binnen harbor of the Elster-Saale canal. It is situated in Flur Leipzig-Lindenau. Etzold (1918) describes it incorrectly as Flur Plagwitz, and this mistake has appeared in several other works (e.g., Braune 1938). On the southwest and northwest walls of this pit the following observations were made during the years between the two World Wars:

30 cm.	Sandy loess; rock pavement with ventifacts.
2.00 to 2.30 m.	Moraine, brown on the surface, lower: gray-brown; it carries many small to medium-large boulders; at times also large boulders.
up to 0.1 m.	Tightly laminated Böhlener Varved Clay or fine sand.
6.00 to 7.50 m.	Elster gravel, becoming generally coarser toward the bottom; at the very top a 1.00 m. to 1.50 m. thick bed of sand; beneath that, especially in the western part of the pit, a 50 cm. to 1.00 m. thick sandy-loam bed which looks like a very sandy and gravelly moraine and perhaps records an early ice-advance. The surface of the gravel is not completely level, for stripping operations have revealed basins, *ca.* 1.00 m. to 1.50 m. deep and aligned approximately north-south, which are probably the last-abandoned stream channels.
	The basal layer is formed of Early Tertiary and Lower Permian deposits.

In spite of the fact that the gravel is free of lime, which causes bad conditions of preservation, mammalian bones were found in this pit, especially at the beginning of the operations when the crushing dredge for mine digging was not used. Most frequent are remains of certain forms of elephants. Rühl (1939) has identified 150 teeth from the main pit in Lindenau (which he incorrectly calls Plagwitz). Of these 4 per cent belong to *Elephas trogontherii antiquus,* an intermediate form; 12 per cent to *Elephas trogontherii;* 18 per cent to an intermediate form *Elephas trogontherii-primigenius;* 56 per cent to *Elephas primigenius;* and 11 per cent to *Elephas* cf. *Leith-Adamsi* n.f., a dwarf form. Important is the appearance of *Elephas trogontherii,* which everywhere in Central Europe became extinct with the Riss Glaciation. In addition to elephants, the following animals have been identified: *Rhinoceros tichorhinus,* frequent; *Equus* sp., rare; *Cervus,* once; *Rangifer arcticus* and *Felis tigris* sp. each once. The animal remains are particularly numerous in the lower part of the gravel, but appear only occasionally in the middle and upper part. Rühl is inclined to place *Elephas trogontherii antiquus* in a warm fluctuation in the Lindenau-Elster gravel. Such a fluctuation is also believed to be present in the Riss gravels of the Salzke near Halle on the Saale, but its existence in Saxony has not yet been demonstrated with certainty.

Etzold, the original discoverer of the Markkleeberg site, supposed that implements must also occur in the gravels of the same age at Lindenau, and he actually found some in the main Lindenau pit. In his work (Etzold, 1918: fig. 109, no. 3) he describes one of them as a bevelled, slightly oval, convex scraper. Additional tools were found later by other collectors in this large pit. Up to now these pieces were little known, but they are of great value, because of their clearly-defined stratigraphic position in the gravels, their association with remains of *Elephas trogontherii,* and the fact that the overlying moraines have clearly been determined as of Riss age. Definitely from Riss gravel laid down by the Elster in the western part of the town of Leipzig comes a point, which was found in a ditch in a garden and described by Braune (1938).

The Riss gravels laid down by the Mulde, easily recognizable by the cobbles of granulite which they contain, cover the area southeast of Leipzig, and are overlain by Riss ground moraine. For this reason they are exposed only at a few places. Furthermore, in the northeastern suburbs of Leipzig there were formerly a few pits in the Mulde gravels, above which this same moraine was preserved. Neither animal remains nor artifacts have yet been found in the completely calcium-free Mulde gravels. The surface of the gravel terrace has a slope of 1 : 900 to 1 : 1,000. The Middle Terrace of the Mulde drops here to 109.5 m. above sea level, i.e., to the same height as the Elster terrace of the same age with which it merges. To the north of Leipzig the Riss terrace of the united Elster-Mulde has a width of 17 km., which is covered with thick moraine formations of the Riss ice and can be traced only by borings. But, on the northern valley slope of the flood plain of the westward-flowing Elster, below Leipzig, this gravel has been tapped and opened by pits. In two such pits to the west of Leipzig, Jochen Heckt, then a student at Leipzig, collected some fragments of flint tools in 1937 (Grahmann, 1938*b*). Furthermore, in 1926 near Leipzig-Wahren while working in thrown-up Riss gravels of the Elster-Mulde, a child discovered a beautiful almond-shaped point, which was first illustrated by Braune (1934); it is reproduced in the present monograph (fig. 62, no. 6).

The Riss gravels of the Pleisse follow the present flood plain on the western side of the river, and below

Rötha they are also found on the opposite side. The gravel mainly carries boulders of quartz, which come from Paleozoic and Tertiary deposits. Added to these are 12 to 15 per cent of other cobbles from the rock formations to the south, and 3 to 5 per cent cobbles of northern origin derived from the Mindel moraines. For the most part the gravel is gritty and pebbly, but on the eastern bank, where it overlies Tertiary sands, sandy layers are frequent, especially in the upper part.

The thickness of the Pleisse gravel is usually between 5 and 6 m. The declivity amounts to about 1:800 and becomes less towards the junction of the Pleisse terrace with the Elster, south of Leipzig. The Pleisse terrace here has a width of 6 kilometers. Already in the long, tongue-like terrace remnant between the modern flood plains of the Elster and the Pleisse, cobbles from the two rivers are mixed. The Pleisse gravel is mostly covered by basal moraines of Riss age. This can be observed in numerous gravel pits west of the Pleisse flood plain, but even more clearly in the surface brown coal mines at Böhlen, where the upper layers show at least two advances of the Riss glacial inland ice. Thus the geologic position of the Pleisse gravel is especially clear here. Furthermore, during the work in the lower part of the Pleisse gravel a plant-bearing clay bed was exposed, an analysis of which has an important bearing on the climate during the accumulation of the gravel (Grahmann, 1924). Since the evidence from Böhlen is very complete, the section is given in figure 3 in simplified form.

The plants consist mainly of mosses and reeds, together with water and marsh plants. To judge from these, the assemblage grew in a true tundra marsh, into which a few water plants, as well as the seeds of some land plants, were washed. Of woody plants only thin twigs of small-sized willows were found. Pollen is extremely rare. In five 18 × 18 mm. preparations only the following could be found: *Pinus:* 4; *Betula:* 5; *Salix:* 8; Cyperaceae: 8; Gramineae: 28; probably *Empetrum nigrum:* 2. The quantity of tree pollen is so small that it may have been blown in from far away. Moreover, it is likely that the pollen was derived from creeping willow, dwarf-birch, and mountain pine. Taken as a whole, these plant remains from Böhlen prove the existence of a high arctic climate in a completely treeless tundra-like landscape. The latter was at least temporarily inhabited by man, for in the Pleisse gravel at this locality, Otto Karl of Leipzig discovered five unrolled tools of Markkleeberg type. Several other pits in the more northerly located communities have also yielded similar finds.

On the eastern slope of the Pleisse valley the ground moraine overlying the gravel is completely eroded away except for a rock pavement, but in some cases it is washed away completely. Artifacts occur in almost all gravel pits located along the eastern valley slope. Farther to the south also such artifacts are to be expected but to date they have not been looked for. Finds are relatively frequent only in the pits of Zehmen, Cröbern, and Markkleeberg (figs. 8 and 9), and these will be described in the next section of this monograph. Here, it should be stated, however, that at Markkleeberg mammalian remains, as at Lindenau, occur mainly in the lower part of the gravel. In 1939 W. Rühl determined that 12 per cent of the elephant species belonged to *Elephas trogontherii,* 20 per cent to *E. trogontherii-primigenius,* 64 per cent to *E. primigenius,* and 4 per cent to *E.* cf. *Leith-Adamsi.* He also established the presence of a fauna which indicates a cold climate.

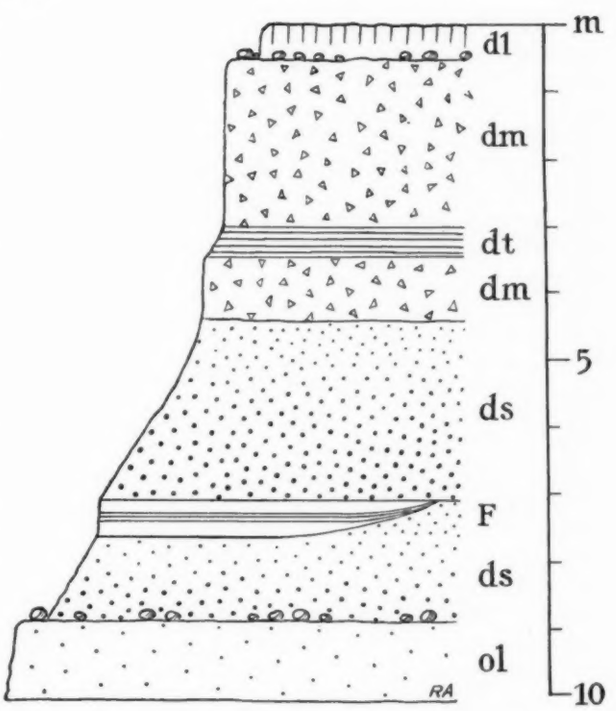


FIG. 3. Pleistocene sequence at the Böhlen Lignite Mine, near Leipzig.

dl = Loess with basal stone bed.....Würm
dm = Ground moraine in two beds representing two stages of glaciation. Separating these there are:
dt = Böhlen Varved Clay laid down in an ice-dammed lake formed at the margin of the ice front.
ds = Pleisse gravels with large rolled stones at the base primarily derived from the Mindel moraines.
F = Clay bed with peat at the base, the plant-bearing horizon.
} Riss
ol = Middle Oligocene marine sand.

It is characteristic of the Riss gravel in the Pleisse Valley north of Böhlen that, here and there, discontinuous beds of pure, but generally sandy or gravelly, unstratified loam *ca.* 50 cm. to 1.00 m. thick are intercalated, particularly in the upper part of the gravels.

They are generally intricately contorted within themselves or infolded with the underlying and overlying gravels. For this reason, they were originally interpreted as moraine (Grahmann, 1925). Although this interpretation may be correct in some instances, in most cases the beds are flood plain loams. They do not constitute evidence of climatic change, but are rather the consequence of an increased water-free surface because of diminution of river volume prior to the arrival of the Scandinavian ice.

The wide dispersion of the Riss glacial gravels near Leipzig may be seen on the map (fig. 2). The contemporaneity of the various gravel deposits can be shown by the accordant slopes of the terrace surfaces which merge into each other without perceptible break. In the case of the Elster gravels at Lindenau and the Pleisse gravels at Markkleeberg, contemporaneity is also shown by the fossil content. The appearance of *Elephas trogontherii* proves that the gravel does not belong to the Last Ice Age, and this is further confirmed by the state of preservation of the gravel, as well as by the superposition of ground moraines which could have been deposited only during the Riss Glaciation. The presence of *Elephas primigenius,* Woolly Rhinoceros and Reindeer, which usually indicates a cold climate, in addition to the flora found at Böhlen (which contains no woody plants, with the exception of creeping willow and perhaps mountain pine, as well as dwarf birch) demonstrates that these Middle Pleistocene gravels were laid down under completely arctic conditions, at the time when the Riss ice was advancing slowly from Scandinavia over Central Germany. Therefore the gravel certainly dates from Riss times, particularly the early stages of this episode. Thus the very thick gravel in question represents a monogenic sediment, geologically speaking, of short duration of formation.

How many thousands of years the laying down of the river gravel lasted can only be estimated. The accumulation began during very cool climatic conditions when the mountainous and hilly country in the Leipzig region was treeless and the glaciers of the Scandinavian highlands had begun to move towards the south. It ended with the arrival of the northern ice-sheets. On the basis of counting varved clays near Leipzig, a yearly advance of the ice has been determined of about 110 to 120 m., but this may be too high a calculation (Grahmann, 1925). It would mean that the inland ice took only 13,000 to 15,000 years to travel the long distance from Central Scandinavia to Leipzig, and that the deposition of the gravel took, at most, equally as long. Soergel (1937) has given, in his glacial chronology based on the values of Milankovitch's (1930) radiation curve, the same duration for the advance of the Riss Glaciation. If one accepts the calculations of Milankovitch as explaining the causes of the Ice Ages, and thus the basis for an absolute chronology of the Pleistocene, the deposition of the Riss gravels of the Leipzig region would have occurred approximately 240,000 to 225,000 years ago.

The foregoing discussion has shown that the area near Leipzig was covered with extensive sand and gravel surfaces at the beginning of Riss times. The rivers of this stage flowed through many-branched and continually changing beds. Only the melting snow, which introduced the short summer, brought a sufficient volume of water to feed the streams, but the sand and gravel areas lay dry for a long time, barren and sterile under the effect of the fall winds which swept down from the glacial ice and imprinted the stamp of the cold treeless tundra. Plant growth only occurred on the gravel plains near and in the old water channels.

The tundra with dwarf willows, probably also *Empetrum nigrum,* Vaccineae, Cyperaceae, and Gramineae (moss and lichen), was confined to the non-gravel covered land. Southeast of Leipzig, between the gravel terraces of the Mulde and Pleisse, with the Goessel, this formed a long outstretched strip of land which extended to the western suburb of Leipzig. Here the broad terrain of the desert-like Elster gravel narrowed and was interrupted by a few islands which probably carried tundra. This relatively small passage appears to have been used by migratory animals, thus providing plenty of game in the area south and southeast of Leipzig. This attracted man and, particularly near Markkleeberg on the eastern rim of the gravel plain between river and tundra, the region time and again offered favorable hunting and living conditions.

On the basis of these geographical conditions, which are shown on the map (fig. 2), one must assume that the Riss gravels to the northwest of Markkleeberg, toward the tip of the land tongue, were also rich in tools. Here the gravel of the preceding Interglacial Period was completely leveled, and, as a result, the stone implements were incorporated into the more recent gravel. It is probably due to this fact that rolled implements occur in the gravel below the loam within the Elster flood-plain west-northwest of Leipzig. Typologically these artifacts conform with those from the Pleisse glacial gravels of Riss age and presumably were originally derived from them.

One may gain an even more impressive picture of geographical conditions during the Riss Glaciation if the problem is considered from a broader perspective. Figure 4 shows, for a portion of Central Germany, the distribution of the gravel surfaces during the Riss Glaciation in the last millennium before the advance of the northern inland ice. One recognizes that the Elster-Mulde Valley, joined north of Leipzig, shows an extremely broad plain of gravel deposition. Its eastern limits are as yet unknown, and it is not impossible that a juncture exists between it and the contemporaneous

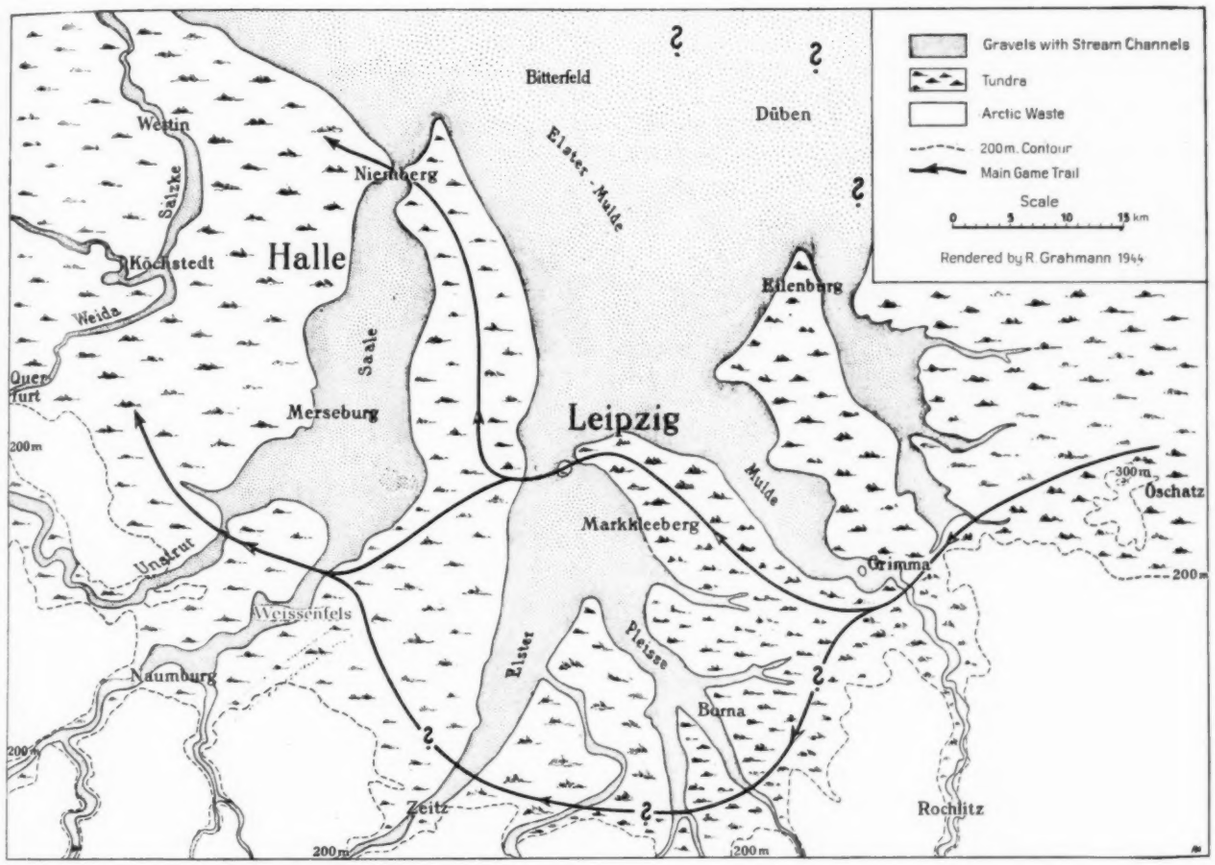


FIG. 4. Distribution of Riss glacial gravels in the Leipzig region of Central Germany.

and equally widely distributed Elbe river gravel. But even if such were not the case, the width of the gravel deposition extends far more than 30 km. To the west there is a gravel terrace of the Saale 8 to 12 km. wide, which becomes very narrow between the Porfy heights near Niemberg and flows into the gravel deposits of the Elster-Mulde. However, the land west of the Saale completely lacks such gravel areas and, therefore, probably was the objective of the migratory animals.

As mentioned above, one must assume that the sterile sand and gravel areas were largely, if not totally, devoid of plant growth, and incapable of supporting herds of game. But the extent of the tundra was limited, since the land rises gradually to the south toward the heights of the Thüringian Forest and the Iron Mountains. With the crowding of vegetation levels in cool climates one expects that plant growth ceased at a relatively low altitude, and that the barren lands were avoided by the animal world. In figure 4 the 200 m. contour has been adopted as the southern limit of the tundra. In this connection it should also be recalled that, owing to the depression of the ocean level during the Riss Glaciation, the land stood at least 100 m. higher with respect to the sea than it does at present. This had an unfavorable influence on the climate (Grahmann, 1937). Naturally, the southern boundary of the tundra did not follow precisely the 200 m. contour line, but was influenced locally by differences in the soil, damp areas and exposure to the sun. But these local deviations do not greatly influence the general impression that in the Leipzig region only a rather narrow strip of tundra between the barren gravel fields to the north and the rising, bare, rocky mountainous regions to the south was at the disposal of the fauna in its east-west or west-east migrations.

The almost mandatory routing of the game trails south of Leipzig is apparent on the basis of the evidence set forth above. It induced frequent visits of hunting peoples, who could easily cross the Saale either below Weissenfels or near Niemberg. Near Weissenfels there are gravel pits in which artifacts have been found, but near Niemberg the gravel lies beneath the Riss moraines and is not exposed. Towards the east an important passage may have existed near Grimma, but here there are no favorable exposures.

The possibility should also be considered that a second east-west route existed farther to the south where the gravel streams were narrow. But here the

terrain between the valley paths is higher, and the plant growth is correspondingly more sparse. Nevertheless, in connection with future investigations this possibility should be considered. For the valley paths which were fairly far south would have been preferred for climatic reasons, and therefore probably were sought out by game.

3. THE LOWER PALAEOLITHIC SITES SOUTH OF LEIPZIG

As stated above, Lower Palaeolithic stone implements have been found at many places in the Riss gravels near Leipzig. Since all these localities are of the same age, it is justifiable to refer to them as the "Leipzig Localities." But the most prolific sites are all situated south of Leipzig in the fields of Markkleeberg, Cröbern, and Zehmen, as already mentioned. All the finds from these places come from sand and gravel pits. Probably one would find it profitable to search all the fields systematically where the Riss gravels of the Pleisse River occur, but so far this has not been done.

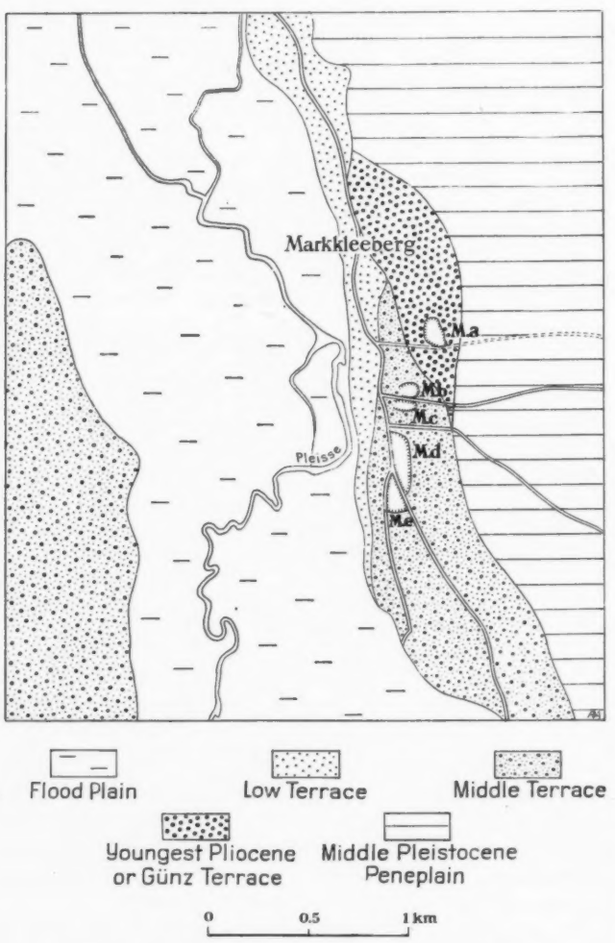


FIG. 5. The gravel terraces of the Pleisse Valley near Markkleeberg.

The Markkleeberg sites were denoted with the letters *a* through *e* by Jacob-Friesen (1914), and these designations are still used. Since the pits in the fields of Cröbern and Zehmen are also to be distinguished by letters in the following discussion, the designation will be preceded by the capital letter of the names of the fields. Thus the Markkleeberg pits are called *Ma* to *Me*, those of Cröbern *Ca* to *Cc*, and the Zehmen pits *Za* to *Zc* (compare figs. 8 and 9).

Pit *Ma* was first mentioned by Schmidt (1913), who described its sands as early glacial; these are shown on the geological map as Miocene. Jacob-Friesen states that no archaeological material was ever discovered in the gravels of this pit. Indeed the gravel at this site is completely free of flint and belongs to the earliest established pre-glacial terraces of northwestern Saxony. These are placed, with reservation, in either the Günz Period of the Alps or in the Late Pliocene (Grahmann, 1925).

Pits *Mb* to *Me* (figs. 5, 8, and 10) are all in the Riss gravels of the Pleisse River and present basically the same picture. In 1895 Etzold (1918) collected the first palaeoliths in pit *Mb*, and most of the 300 pieces found by him are from this site. Since only limited operations were conducted at this pit, it never had a large horizontal extent, but it must have been a very lucrative locality. Therefore, it is unfortunate that work here was discontinued so early. According to Etzold the following profile occurs at *Mb*:

1.00 m. Loose, loamy sand with few large boulders, often involuted and faulted.
1.50 m. Even-bedded sand.
2.30 m. Coarse river gravel, colored a rusty red by weathering. Contains thin seams of fine-grained sand and a few northern erratics which become more numerous in the lower levels.

All of these layers belong exclusively to the Pleisse gravel. Essentially similar was the profile in pit *Mc*. In 1925 one could still notice that there was a rock pavement of generally northern boulders above the river sand, which was overlain by a mantle of loess 50 to 75 cm. thick. At present, pits *Mb* and *Mc* are inactive and are used as gardens.

Pit *Md*, which was formerly known as "Anton Berndt's Gravel Pit," was opened about 1908. Since then it has been almost constantly in operation; it has finally reached a length of 200 m. and a width of more than 100 m. The majority of the pieces published by Jacob-Friesen, as well as those collected by other workers, come from this pit. Thus it is the most important of the Markkleeberg sites. Along the east wall of the pit, where the exploitation proceeded, the bedding conditions have been observed for many decades, but at present this is only possible in the northern part of the pit where the exploitation has continued and where artifacts are still being found. Pit *Me* was abandoned in the 1920's and houses have now been built on it.

The section opened at the eastern wall of pit *Md* is reproduced in figures 6 and 10 (p. 529). At the base is a fine grey sand (1) which is of Upper Oligocene age. The sand is disconformably overlain by a 2- to 4-meter thick series of sandy gravels (Bed 2). In the lower part of the pit the sand occurs in layers which compensate for the somewhat uneven surface of the substratum; higher up, however, the sand almost always exhibits horizontal layering, characteristic of the gravel of the rivers of this region. Most of the pebbles are nut- to apple-sized and lie in a sandy matrix. Quartz is the most abundant pebble material. The remaining pebbles show by their provenance that we are dealing with an old Pleisse gravel. Often pebbles of Scandinavian or Baltic origin are to be found, especially flint. Large northern erratics, so-called boulders, lie at the base of the gravel, and they are all derived from destroyed moraines of Mindel age.

Those pebbles containing feldspar have become soft and rotten through weathering. Even large blocks of northern granite or gneiss are sometimes so badly decomposed that they crumble into coarse sand when struck. This weathering process has made the gravel slightly loamy, and it has resulted in the separation of rust-brown iron salts which become generally more frequent in former ground-water zones. The gravel yielded the remains of a cold fauna mentioned in the preceding section. According to the workmen, such remains are usually in the deepest part of the deposit. This does not necessarily mean, however, that these animals did not live here when the upper layers of the gravel were laid down. On the contrary, there is a greater chance of bones being preserved in the hard ground-water of the lower gravel layers than under the influence of the infiltrating rain water, rich in carbonic acid, which is leaching the upper parts of the gravel.

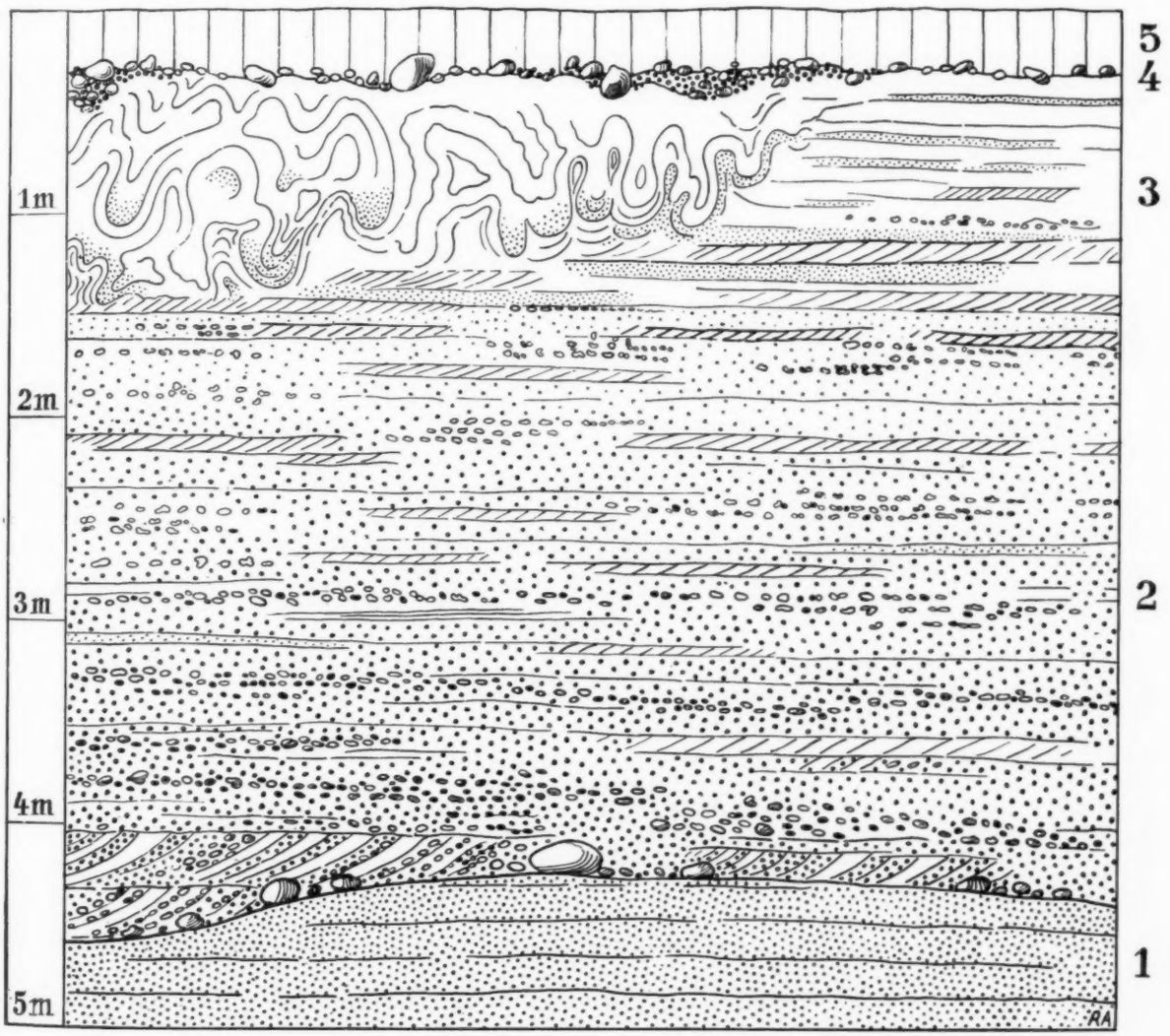


FIG. 6. Stratigraphy in sand and gravel Pit *Md* at Markkleeberg.

As a rule the sandy Pleisse gravel changes in the upper part quickly into a sand which is likewise arranged in completely horizontal layers (Bed 3). This is up to 1.50 m. thick and generally contains no cobbles. Here and there, however, there are concentrations of the latter, particularly in the lower part of Bed 3, so that a very slow transition of gravel into the sand occurs. This condition, as well as the similarity of pebble content, shows that the sand of Bed 3 was deposited immediately after the Pleisse gravel. As a result of the decreasing volume of the river, the grain-sizes became smaller and brought about the absence of larger pebbles.

To a certain extent this sand has become loamy as the result of weathering. In places its bedding is completely absent, and it has been contorted and moulded together. Sometimes this transformation affected only the uppermost part, but in some instances the entire thickness of Bed 3 was contorted, so that it appears now as a structureless sandy loam overlying the river gravels. Here and there larger pebbles are admixed, and it has the appearance of a sandy ground moraine. In fact it was considered as such (Grahmann, 1925) until new exposures showed that this structureless sandy, gravel-like loam changes toward the base and also laterally into sand with normal horizontal bedding. Therefore, the loam originates from this sand as a result of later transformation. The intricate convolutions, which extend into the upper part of the underlying gravel, are the product of the climate of Riss time and prove that soon after its deposition the sand was no longer covered by water in places and thus was exposed to frost action. Sometimes, however, sections may be observed where it seems as if the sand was thrust southward; this results from the pushing forward of the advancing inland ice of the Riss Glaciation. The decalcification of the layered and mixed sand, as well as the strong weathering of the gravel, occurred primarily during the Last Interglacial (Riss-Würm times).

The locally convoluted sand (Bed 3) is covered by a layer of large pebbles (Bed 4), which are often as large as a fist or a head, and at times reach the size of boulders. They are generally of northern origin and doubtless represent the remains of a moraine which originally covered the sand, but was later completely washed away, except for the heavier boulders. Such a mosaic-like concentration of residual boulders is not infrequently observed in Germany. As mentioned above, it is generally called a "rock pavement." In pit *Md* this phenomenon can be clearly observed almost everywhere (compare figs. 6 and 10). At some spots the rock pavement changes into a coarse, sandy boulder clay, which extends down into the sand in a pocket-like fashion and is 50 to 75 cm. thick. Similar occurrences may be observed commonly in the ground moraine of the Riss Glaciation. Meanwhile fragments from the

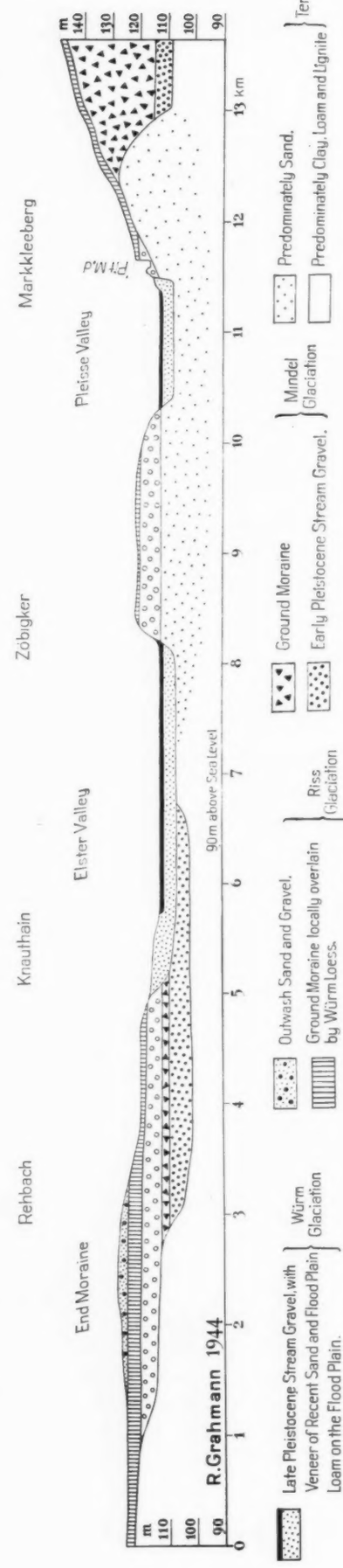


FIG. 7. West-East Section through the Riss glacial gravel deposits of the Pleisse and Elster Valleys near Markkleeberg.
Vertical scale exaggerated 25 ×.

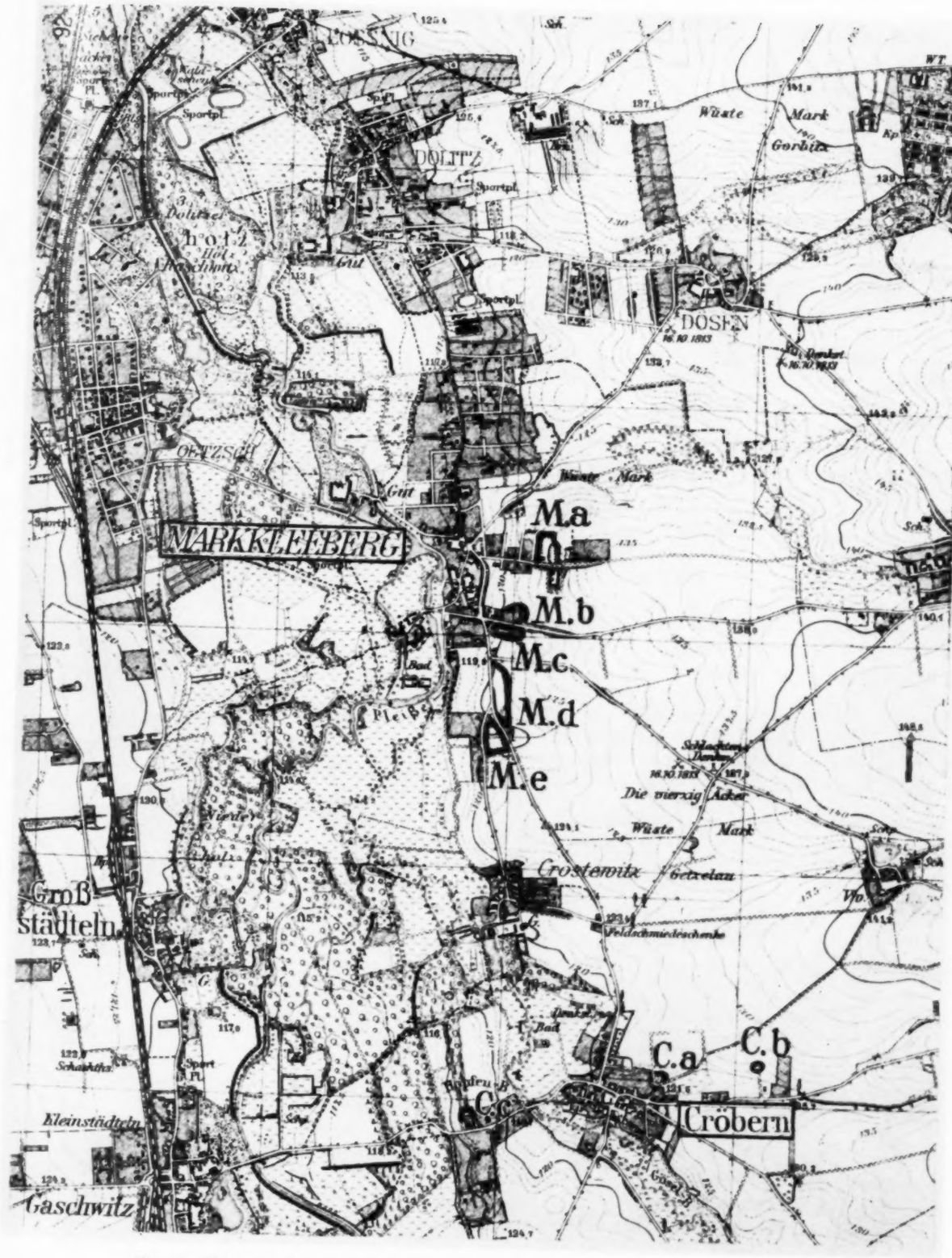


FIG. 8. Map showing the Markkleeberg and Cröbern localities. Scale = 1:25,000.

rock pavement were added to the underlying sands by more recent congeliturbation, or have been intimately mixed with it. Since the wastage of the ground moraine into a rock pavement took place during the Last Interglacial Period, this intermixing must have occurred under the conditions of the glacial climate at the beginning of the Würm Glaciation.

Hesemann (1937) has discovered that the stones in the ground moraine preserved in pockets consist of 22 per cent Rapakiwi granite and 62 per cent rocks from Southern Sweden, which is normal for Riss moraines in Central Germany. The Pleisse gravel, on the other hand, which contains 55 per cent of East Baltic rubble and only 17 per cent of constituents from Southern Sweden, clearly shows that its pebbles of northern origin came from the Mindel ground moraine. In this manner the age of the sequence of the Markkleeberg deposits may be determined.

The Markkleeberg finds occur close to the eastern border of the gravel deposits which accumulated as a transgressive process. Therefore, the basal portion exposed in the Markkleeberg gravel pits does not represent the lowest point of the valley cutting attained by the Pleisse River during Mindel-Riss times. The lowest part of the valley lies further to the west as may be deduced from figures 2 and 7. Thus the gravel deposition began at Markkleeberg a little later than further to the west, and also later than at Lindenau, where the gravel is even thicker. As is typical of glacial river gravels, one can observe at Markkleeberg a progressive refinement in the size of the rubble toward the top of the section. The implements are mainly found in the gravel; they seldom occur in the overlying sand.

On the basis of the evidence presented above, the sequence of layers in Pit *Md* is as follows:

Würm Glaciation	Drifting of sandy loess. Formation of ventifacts. Latest congeliturbation.
Third Interglacial	Washing away of the ground moraine to a rock pavement; loaming of the basal sand.
Riss Glaciation	Ice advance and deposition of the ground moraine; contortion of the basal sands. Older congeliturbation. Deposition of sand. Deposition of gravel.
Second Interglacial	Down-cutting of the Pleisse Valley through the formations of the Mindel Glaciation into the Oligocene beds.

In Cröbern, a community located 2 km. south of Markkleeberg, three pits have furnished implements. At Pit *Ca*, 200 meters east of the community and near point 121.5 of the Ordnance Survey, a 50 to 75 cm. thick layer of sandy loess with an underlying rock pavement overlies Pleisse gravel, which was rather sandy near the top and became gradually more gravelly toward the base. Its thickness varied; in places where it was exposed it was up to 4.00 meters. Fossils were not secured, but worked tools were collected from the pit with the aid of the workmen. At the present time, the exploitation is suspended and the sections are completely obscured. Pieces have also been collected in the abandoned Pit *Cb*, 400 meters farther towards the east. Pit *Cc* is located to the west of the village of Cröbern near the Hopfenberg, but the area is now built up with houses. In the beginning of the 1920's one could observe the following section:

60 cm.	Sandy loess.
1.00 to 1.50 m. .	Brown boulder clay.
3.00 m. and over	Brown, ferruginous gravel, in horizontal beds.

Etzold (1918) reported that here the ground moraine was still calcareous and underlain by a banded clay. Hence a sequence of deposits of the Riss Glaciation was temporarily exposed at this locality. Werth (1915) states that artifacts were found in this pit, but nothing is known of later finds.

Several gravel pits are located in the neighboring village of Zehmen, to the south near the eastern margin of the valley. The most northerly pit, *Za*, was opened in 1931. The exploitation was done by dredging and the stratigraphy is the same as at Markkleeberg:

50 cm.	Sandy loess with underlying rock pavement (slightly developed).
2.00 to 2.50 m. .	Horizontally-bedded river sand.
4.00 m. and over	River gravel in horizontal beds.

Locally the sand is overlain by gravel and apparently it represents an intercalation in it. The gravel is brown and weathered; involution or frost-heaved layers do not occur at this pit, and no fossils have ever been found here. From the dredged material a very few flake artifacts have been collected.

In Pit *Zb*, located 200 meters farther south, as well as in the even more southerly Pit *Zc* at Zehmen, the same sequence of deposits may be observed:

20 to 30 cm. ...	Sandy loess with underlying rock pavement (only slightly developed).
1.00 to 1.50 m. .	Horizontally bedded, medium to coarse gravel.
50 cm.	Reddish loam strongly mixed with both the basal and overlying gravel layers.
4.00 m.	Horizontally bedded gravel.

The gravel is brown and weathered, and the embedded loam horizon is discontinuous. Mammalian remains are unknown in this pit; however, it furnishes a rather large series of implements, especially from the lower gravel layers. These implements were mostly collected by Mr. Schulte of Leipzig.

In all the above-mentioned pits, with the exception of Pit *Za*, the exploitation of the gravel was done by hand, that is to say, by cutting trenches and breaking down small sections of the walls. Normally the ma-

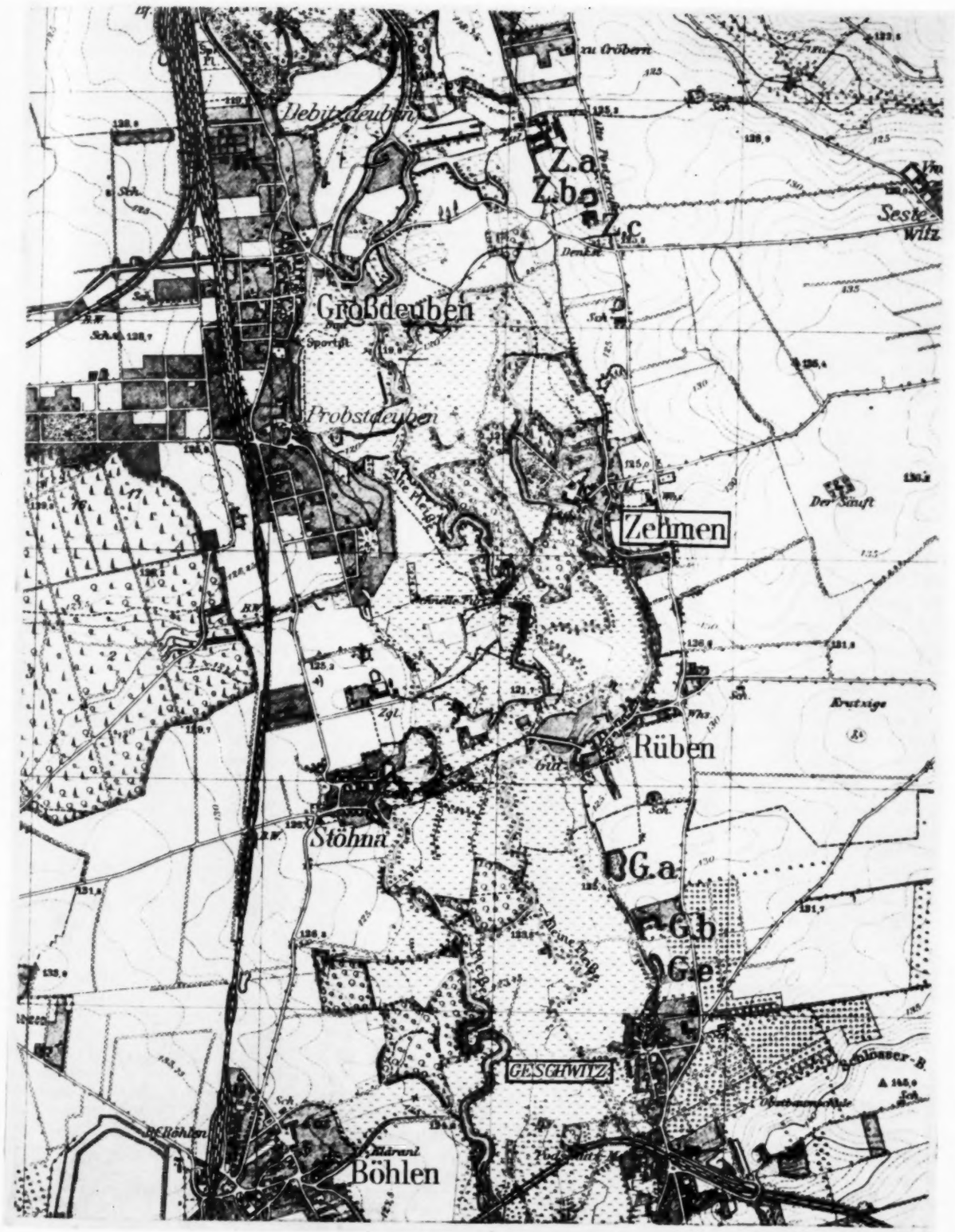


FIG. 9. Map showing the Zehmen and Rötha-Geschwitz localities. Scale = 1 : 25,000.

terial which was thrown down was sifted. In this manner the workmen recognized the blade artifacts by their sound, and they also observed the occurrence of other types of implements which remained in the unsifted material. Naturally in such an exploitation, a horizontal control of the collecting is impossible, and one very seldom succeeds in extracting a good piece *in situ* in the section. Nevertheless, attentive collectors and workmen have experienced that not all the horizons in the gravel are equally rich in stone implements; in general these occur in layers, and even in clusters in certain instances.

The collector F. Mann reports that the lowest artifact-bearing horizon in Pit *Md* occurs at the base of the gravel, and that others are to be found about 1.00 and 2.00 m. above. According to him, in Pit *Ca* the lowest archaeological stratum is at the base of the gravel, the second one 1.20 m. higher up, while there is a third one approximately 2.00 m. above the base. In Pit *Zb* the lowest artifact-bearing layer is stated to occur at the base of the pit 1.00 to 2.00 m. above the Tertiary deposits. Some 2.00 m. higher there is a second one, while a third one occurs 4.00 m. above the base of the pit, immediately below the above-mentioned loam bed. Mann points out explicitly that no difference can be noticed with regard to the type, work, and preservation of the tools from the various archaeological horizons.

If this information is correct—and we put it forward with all reservation—we would have to assume that there were formerly three settlements on the banks of the Pleisse, which may have taken place during intervals of slightly improved climatic conditions. According to the experiences of other collectors, including my own, the definition of the artifact-bearing horizons given by Mann does not appear to be completely reliable. It is certain that the artifacts are more frequent in the layers which he specifies than they are in the intervening deposits, but whether or not they are continuous has not been proven for the Markkleeberg Pits, let alone for the Pleisse gravel deposits as a whole between Zehmen and Markkleeberg.

Judging by the sites at Markkleeberg, Cröbern, and Zehmen, one must always bear in mind that we are not dealing with artifacts from transitory or permanent occupation sites, but with the cultural remains of groups of people who appeared on the banks of the Pleisse River at different times over a period of many thousands of years duration. They were hunting here and also they manufactured their tools here. Some of these tools remained in their original position, and some were transported by water for a certain distance before they were covered up by and included in the river gravels. At first they lay in the ground-water and were thus exposed to a certain amount of weathering. During the following Riss-Würm Interglacial and also during the Post-Glacial Period, the ground-water level was lowered with the depression of the Pleisse Valley, and hence the gravels containing the implements were altered. In other words, the gravels decalcified through the decomposition of aluminous and ferruginous minerals and assumed a brown color. Thus many of the artifacts acquired the same brown patination as that

FIG. 10. Markkleeberg—Pit *Md*.

1. View from the north taken by K. Reincke in September, 1944. The major portion of the pit is now abandoned and under cultivation. Exploitation, which still produces artifacts, takes place at present only in the outer part of the northern sector of the pit, but it is planned to level the area off for building purposes in the near future. In the left background a few houses of the village of Crostewitz are visible, as well as the spire of the church at Cröbern.

2. The northern sector of pit *Md* looking toward the southeast; photo taken by K. Reincke in September, 1944. On the left and to the right of center may be seen the horizontally-bedded Pleisse gravels, the upper part of which passes into sands. Overlying these sands a concentration of boulders derived from the Riss ground moraine is exposed on the left of the photo. The uppermost 30–40 cm. consists of sandy loess of Würm age. The large boulders lying at the base of the pit are of northern origin; they are derived from the Riss ground moraine, which almost everywhere has been washed away, except for a "rock pavement." Therefore, they originally occurred below the sandy loess, and fell into the pit during its exploitation.

3. Photograph taken by R. Grahmann in August, 1944, showing the eastern face of the pit. At the base are northward-dipping beds of Pleisse gravel. These are overlain by horizontal layers of gravel, which grade upward into sand. The uppermost part of the sand has been contorted as a result of congeliturbation during Riss times, and subsequently it has become loamy owing to weathering during the Riss-Würm Interglacial. Particularly in the right half of the photo the "rock pavement" can be seen very distinctly overlying the weathered sand. In the left-hand part of the picture, on the other hand, sack-like convolutions of ground moraine, rich in rubble, extend into the loamified gravels. Similar occurrences of this same phenomenon, although on a smaller scale, may be noted in the right half of the photo; they are probably the result of congeliturbation during the Würm Glacial Stage. Sandy loess of Würm age overlies the "rock pavement," the constituents of which were abraded by the wind in the early stages of loess deposition.

4. View showing the eastern face of the southern part of pit *Md* taken by R. Grahmann in January, 1935. The lower portion of the section is buried under large boulders which the frost has dislodged from the upper layers. Above them is visible sandy Pleisse gravels the lower levels of which are horizontal, while the upper levels exhibit cross-bedding and pass into sand at the top. The upper part of the sand is contorted in a frill-like fashion as the result of congeliturbation during Riss Glacial times. In the Riss-Würm Interglacial Period these contorted beds of sand were loamified. Overlying the loamy sand there is a "rock pavement" consisting of northern constituents, a vestige of the Riss ground moraine which was washed away during the ensuing interglacial. On the right of the photo remnants of Riss ground moraine occur in sack-like convolutions in the loamy sandy gravel as the result of the congeliturbation of the Würm Stage. Above the "rock pavement" is a layer of sandy loess *ca.* 50 cm. thick laid down at the time of the Würm Glaciation. Many boulders of the "rock pavement" were abraded by the wind (ventifacts) at the beginning of this glacial episode.

FIG. 10

displayed by the unworked pieces of flint in the gravels.

It should also be mentioned that under the conditions of exploitation described above, the basal stone layer may also fall together with the down-slipping mass of gravel. In this horizon artifacts may be found which may have lain upon the land surface of the Last Interglacial Period prior to the deposition of the sandy loess. One should expect such pieces to be unrolled and to exhibit a white patination. With the drifting of the sandy loess, the objects may have become abraded by the wind. In spite of frequent searches at Markkleeberg, however, no implements have ever been found in this horizon.

On the other hand, a few pieces were secured from the masses of gravel which are unrolled and show the beginnings of white patination, and in two cases, on the basis of the sticky sandy loess, have probably lain in the basal stone layer; examples are: the small blade, fig. 41, no. 8, and the oblique-ended blade, fig. 48, no. 5. But they do not vary in any way from the general typology of the series as a whole, and since the white patination is slight and has only reached the edges of the implements, it is to be assumed either that such pieces originally belonged to the uppermost layers of the Pleisse gravel, or else that they came to the surface through the interlacing of the Pleisse sand. Then they may have been covered by the Riss ground moraine, exposed only after the latter had been washed away towards the end of the Last Interglacial Period. Until the beginning of the deposition of loess, they acquired a whitish color under the influence of weathering. Furthermore, the theory cannot be excluded that if in the Markkleeberg Pits, as well as in those of Cröbern and Zehmen, implements occur which were manufactured during the Last Interglacial Period, the presence of these certainly cannot have escaped the trained eye of all the various collectors. For, in addition to the above-mentioned somewhat atypical pieces, Neolithic implements, which have dropped from the land surface, provide clear proof of the attentiveness of the collectors.

4. SUMMARY

The existence of three series of glacial deposits in the region of the lowlands surrounding Leipzig has been demonstrated. These correspond to the Mindel, Riss, and Würm Glaciations of the Alps. During the Mindel and Riss Glacial Stages, Northwest Saxony was covered by ice from Northern Europe. The first advance had the greatest extension; it ended 70 km. south of Leipzig. The limit of the second was 30 km. south of the city, but during the Würm Glaciation, the Scandinavian ice did not cross the Elbe (compare fig. 1).

During each advance a cold glacial climate prevailed, even in the non-glaciated regions of Central Germany, which was similar to present-day conditions in the Arctic. Tree growth, let alone forests, was completely absent. The lowlands supported tundra. The mountains were completely bare, and owing to strong frost were covered with mantles of rock waste. As the combined result of the reduced transporting power of the streams and cryoturbation, waste material from the slopes reached the valley floor in such quantity that the rivers could not carry it all away and consequently their beds became elevated. Hence, the beginning of each glacial stage in Central Germany is marked by the aggradation of river gravel; in the Leipzig lowlands these are 6 to 15 m. thick.

During the two older glaciations, ground moraines and often glacial water formations as well were spread over the river gravel. In Würm times, however, in addition to the accumulation of the low terrace in Central Germany, loess was formed, consisting of a deposit of dust which was brought here by anticyclonic winds blowing from the glaciated tracts. In the Leipzig lowlands these formations seldom reach a thickness of one meter; only farther south are thick deposits of loess common. The glacial formations were weathered under the conditions of the warm interglacial climate; moreover, again they were partly washed away as a result of the newly effective erosion. In particular this holds true for the long Mindel-Riss Interglacial Period, in which the originally very thick Mindel moraines were completely destroyed over a large area.

In the Leipzig region the Lower Palaeolithic finds come from the river gravels. Their stratigraphic position is determined by the transporting power of the stream, their altitude in the longitudinal valley profile, their state of preservation, and the superposed layers; in some cases we also have paleontological proof of this. In view of all these criteria, the artifact-bearing river gravels near Leipzig *without doubt belong to the first part of the Riss Glaciation.* This is demonstrated for the localities at Markkleeberg and Lindenau by the occurrence of *Elephas trogontherii,* which becomes extinct during Third Glacial times. Both the flora and fauna show that a very cold tundra climate existed during the time of gravel formation.

As far as the Riss Glacial Stage is concerned, we may infer from both the geological and geographical evidence—from the extension of the sterile and barren gravel terraines of the tundra regions and the cold desert-type steppe of the southern hill district—that the area of Leipzig was probably rich in game, and for this reason roving hunters liked particularly to stay here (compare figs. 2 and 4).

The Markkleeberg gravel pits are among the most important sites in Germany for Lower Palaeolithic implements; in second place are those located to the south near Cröbern and Zehmen (compare figs. 8 and 9). In all these sand and gravel pits the same sequence of layers is found which corresponds in general to that shown in figure 6. The Würm Glaciation is usually represented by a thin layer of sandy loess. Below this sandy loess is a basal layer of boulders, the remains of

the ground moraine of the Riss Glaciation which was washed away during Riss-Würm Interglacial times. Boulders in the rock pavement commonly preserve the marks of Würmian wind abrasion. Below that are sands and gravels of the Riss glacial Pleisse gravels, which are about 3.00 m. to 4.00 m. thick. The bedrock consists of Oligocene sands. Everywhere the artifacts are widely scattered in this Pleisse gravel; occasionally they are more plentiful in individual layers even though one cannot prove any primary archaeological stratigraphy. The less productive sites at Böhlen and Leipzig-Lindenau are different from those mentioned above, because here the Riss ground moraine is still fully preserved upon the upper beds of the gravel.

ARCHAEOLOGY

1. THE COLLECTIONS

A detailed analysis of the various individual collections from the Markkleeberg sites reveals occasionally a divergent picture. For instance, in one of the collections there are more blades, in another more retouched pieces, and in a third more crude flakes. This situation is the result of local conditions. At Markkleeberg, as well as at Cröbern and Zehmen, one is not dealing with the stock of tools of a single occupation, but with a cross-section of the cultural material produced over a span of many thousands of years during which similar, but not exactly identical, groups or bands of hunters lived from time to time not only on the banks of the Pleisse, but also at other places somewhere further up the valley. The tools from the more distant localities are probably dispersed rather irregularly in the gravel. On the other hand, those from the more closely situated sites are less scattered in the gravel, and hence they occur in layers or clusters.

From time to time as the exploitation was slowly progressing, these richer zones were found and the artifacts were picked up eagerly by those collectors who visited the pits during the period in question. It could happen also that one of the sand-pit workers helped a certain collector, while a second laborer possibly working in another part of the pit was assisting a different collector. In this manner some collectors obtained a representative series of the material from a certain section of the gravel which was being exploited at the time, whereas other collectors amassed typical assemblages of objects from other parts of the gravel. Thus a person who searched very attentively over a period of years would finally succeed in accumulating a cross-section of the whole of the large pit *Md*.

Furthermore, the alertness of the collector and his knowledge of Palaeolithic implements played an important role. One individual may have recognized only the best and most conspicuous pieces, while another picked up the less beautiful ones as well. And it should not be forgotten that the gravel abounds in natural flint which makes the search for worked tools more difficult and gives rise to errors. A sharp and well-trained eye and a critical mind must always be combined in order to separate the wheat from the chaff.

Finally, it should be borne in mind that the range of materials in a given collection also depends on the extent of the available finances. The sand-pit workers prefer to give their finds to the collector who has the reputation of paying well. Therefore, he received the most beautiful pieces: blades, points, or retouched pieces; while another person who could spend less money was likely to receive only flakes.

I was told of a similar experience at the well-known locality of Barnfield Pit, east of London. In this pit there are rather crude pieces of Clactonian type, as well as Acheulian hand-axes. But the latter were only taken out by people who paid well. On the other hand, a somewhat economic collector received only more or less beautiful flakes, and on this basis he stated that the Barnfield industry consisted only of pieces of Clactonian type.

Since the statistical survey of the pieces of all known collections evens out the errors which result from the above-mentioned practices, one obtains an actual cross-section of the total artifactual material of a relatively short and well-defined period of time from a geological point of view.

Postscript 1946: A large part of the Leipzig collection was destroyed by air attacks on the city in December, 1943. The same happened to the collections belonging to the state during the air attacks on Dresden on the thirteenth and fourteenth of February, 1945; in addition a large private collection of Markkleeberg pieces was destroyed in Bremen. Finally, much of the material was lost as the result of plundering by the occupation forces in Freiberg (Saxony).

2. RAW MATERIAL AND THE STATE OF PRESERVATION OF THE IMPLEMENTS

Figures 11 to 13

Of the more than 3,000 artifacts which have been collected so far at the Leipzig localities, only four which all come from Markkleeberg are made of Lower Tertiary fresh-water quartzite. The latter, sometimes called brown coal quartzite or nodular stone, sporadically occurs in the gravel as rubble of sometimes very large size. The rock is fine, sugar-like, and of light grey color; the unrolled tools are patinated light brown.

All the other tools are made of flint, which originated in various layers of the chalk of the Baltic area and was transported into the Leipzig region by the ice of the Mindel Glaciation. Subsequently it was washed out of the old moraines. Such flint occurred in great quantities near the banks of the stream, especially on the sand and gravel surfaces of the wide, piled up, and plantless terrace areas, and also in the tundra region, as the residue of washed out moraines.

Flint was available to the roving bands of hunters in unlimited quantities. It served as raw material for the manufacture of stone implements, not only as broken fragments, but also very frequently in the form of unbroken original or rolled nodules.

Several kinds of flint were used. Most common is a grey flint, more or less translucent at the edges, but also sometimes completely opaque; implements of this material exhibit a conchoidal fracture and retain their lustre. The color fluctuates from light to dark in a wide range (fig. 12, nos. 1–5, p. 537). Occasionally one finds flint types of semi-dark color, and it seems as if prehistoric man preferred to utilize these conspicuous types when he found them (fig. 15, p. 541). Some pieces contain Bryozoa. They develop into light grey flint, which resembles fine quartzite and which is filled with Bryozoa, whose fractured surfaces are blunt and lustreless. Only rarely does such raw flint occur without any Bryozoa content. One also encounters pieces of shiny flint with rounded areas of opaque flint and vice versa. In their original nodular form all these types display a white chalky crust.

At the other extreme are very dark almost black flints which are shiny on their fractured surfaces. Nodules of this material never have a white chalky crust, but only a thin, rough, dark upper surface. Immediately under the surface, the flint is grey-black, and deeper down it is a lighter grey, or even an olive brown color. Frequently such pieces are veined in different ways, either light and dark grey or olive brown and dark grey. These dark flints are very dense. When they are broken, these pieces have a conchoidal fracture with sharp edges, and certainly they constitute the best raw material in existence for the production of tools. The prehistoric men of Riss times apparently preferred to use this dark flint, since implements made of this material occur relatively more frequently than do natural fragments or nodules of the same substance. The good quality is also revealed by the fact that it has little tendency to weather. Whereas the tools made of the light grey flint have almost always become patinated, the implements made of the dark flint as a rule have retained their original color completely. They show almost no trace of weathering or only a slightly reduced lustre, and sometimes they appear as fresh as if they had just been made.

The patination of the light colored flint is normally a dull brown. The degree of the brown coloring, which was caused by ferruginous solutions contained in the ground waters and in the infiltrating waters of the gravel, varies in intensity. This is due to the use of different raw materials, as well as to the varying conditions of deposition. If an implement has been lying in a fine-grained deposit, such as a clay or loam layer, it is almost completely removed from the influence of air and water, and it remains in rather a fresh condition. But if it is enclosed in the permeable sand or gravel, it is subject to the effects of air, water, and weather. The strongest weathering takes place in the zone where the former ground-water level fluctuated during the course of the year, where alternately ground air and ground water were effective. This process also led to the formation of the brown ferruginous layers in the gravel of the pits. Probably these correspond to a low ground-water level during the Riss-Würm Interglacial Period.

The difference in the depth of the brown impregnation of the artifacts from the gravels is by no means a result of a difference in age. It is also found on the numerous unworked flints which are embedded in the same deposits. Hence, without reservation, one may conclude that the implements which are weathered or patinated in this fashion were made during the time of the deposition of the Pleisse gravel; but soon these tools became incorporated into this formation and subquently they were subjected to the same weathering processes as was the rubble in the gravel.

The majority of the more or less brown-colored artifacts which come from the Pleisse gravel show none or only slight traces of being rolled or polished, proving that they either did not lie at all or only lay for a short time in the running water and were scarcely transported any distance. Therefore, they must have been made very near the site and must have been embedded shortly thereafter. This observation is based on the concentration of the material in certain layers, and from the fact that the individual collections deviate somewhat among themselves as discussed above.

Other pieces which are weathered and rolled in similar fashion resemble the majority of the above-mentioned pieces, but they also shown signs of rolling and polishing, which point to their having been transported by the river in its bed. During this process the edges were rounded and the surfaces acquired a greasy lustre (*cf.* examples in fig. 13, p. 539). Implements preserved in this manner also originated at the time when the Pleisse gravel was deposited. However, they were not manufactured near the sites but somewhere further up the valley near the river. Then they were transported by the latter for some distance, thereby becoming rolled and polished. This probably explains why these implements are irregularly scattered in the gravel and are rarer than the well preserved, slightly rolled and unrolled pieces of recent origin.

Finally, we must consider another much smaller group of tools which are remarkable because of their completely different state of preservation. They exhibit a white- or ivory-colored, or light grey crust, which as a rule displays a porcelain-like lustre. Even pieces made of the very resistant black-grey flint mentioned above can be patinated in the same way. The weathering crust is sometimes very deep, and it even appears that some pieces have been completely transformed in this manner. Later, the original white to yellow

weathering crust in some instances has been patinated an ocherous brown, a chocolate brown, or even a brown-violet, by the action of various kinds of iron oxides.[1] Almost all the pieces in this category were strongly rolled before weathering, but some also show marks of percussion which are younger and expose the fresh stone beneath the thick weathered crust (compare the examples in fig. 11, p. 535).

There is no doubt that objects of this type had a different kind of history than the representatives of the two above-described groups, a fact which has been previously mentioned (Grahmann, 1938*a*). According to the studies of Gehrke (1930; 1933), the white patina develops as a result of alkaline solutions, for example the influence of rain water during the course of many thousands of years. Therefore one must assume that, after they were made, the pieces which are rolled and patinated white were at first in the river, where they were rolled and polished, but subsequently they lay on dry land where they acquired a deep white patina. Later on they were washed into the river bed a second time and were again somewhat pushed around and struck. Finally they were imbedded in the gravel, where in some cases the original light patina received a more or less deep discoloration.

It is not possible that these pieces from the Pleisse gravel reached their final state by the beginning of Riss Glacial times. During the accumulation of the gravel, these pieces would have been swept away, rolled, and polished in the river bed. But, since the river was overburdened with sediments, and built up its bed as a result, it is very unlikely that during this time a rolled piece remained on the river bank for thousands of years and became weathered white. For the deposition of the gravel was transgressive: the river bed and the whole terrace surface were permanently raised by 50 cm. or more in 1,000 years. Under such circumstances an implement would be covered by sand and gravel after a comparatively short time, and become protected from the weathering effects of the surface waters.

The conditions of the preceding interglacial stage were the reverse. During this interval the rivers were not overburdened with sand and rubble, which they carried only in thin layers on the bottom of their beds. The river incised itself deeper and deeper, meandering in the broad valley bottom. Furthermore, as a result of the curving and bending, it was possible that the level of the rubble which had been deposited during the high-water level along the banks of the river was not attained subsequently by the river. Tools which had been carried along and rolled on their way were laid down on the river banks, and here they became weathered under the influence of the warm climate during the course of many thousands of years, as discussed above. Later on, after the change in the climate of the beginning of the Riss Glaciation, the stream became overburdened with debris, and gravel began to accumulate in its bed over the whole width of the interglacial valley floor, thereby raising the base-level. The patinated pieces were once more swept away by the floods and imbedded in the gravel. In this manner it is believed that they finally acquired their present condition.

On the basis of the facts set forth in the preceding paragraphs, two main groups of stone implements may be distinguished from Markkleeberg and neighboring sites by virtue of their state of preservation, the varying conditions to which they were subjected, and the difference in their age.

Preservation Group 1: The rarer pieces of the older group were most strongly rolled and then patinated a porcelainous color. Sometime later they were hit about and partly colored again (*cf.* fig. 11, p. 535). They are older than the Pleisse gravel and probably date from the preceding Interglacial Period.

Preservation Group 2: The weathering consists of a mere brownish color. But, in the case of grey-black raw material this patination is usually completely lacking. These pieces are believed to date from the beginning of the Riss Glacial Period.

This group contains both unrolled and rolled pieces and may therefore be subdivided. If the pieces are unrolled (as for example on fig. 12, p. 537), this proves that they were made near the site; this corresponds to Preservation Group 2*a*. If they are rolled, as in the case of the pieces shown in figure 13 (p. 539), they were manufactured at some distance up the valley, then they were transported by the river to the site. These pieces represent Preservation Group 2*b*.

Each of these groups may be described as in table 2.

Naturally these preservation groups grade into one another imperceptibly. Particularly Preservation

TABLE 2

Preservation Group	Rolling	Weathering	Derivation	Relation to Gravel	Geologic Age
2a	No	± brown	Near the site	Same age	Riss Glaciation
2b	Yes	± brown	Some distance up the valley	Same age	Riss Glaciation
1	Yes ±	Porcelainous or ivory-colored; later patinated brown	Some distance up the valley	Older	Mindel-Riss Interglacial

[1] Since it was not possible to reproduce colored prints in this work, I cite Reid Moir (1935), who illustrates colored prints on pl. XXV showing such white patinated and also later brown-colored flints. Also, the *Guide to antiquities of the Stone Age*, of the British Museum reproduces a colored illustration on pl. II, figure 1, showing an example of deep white patination of a black flint piece.

TABLE 3

Preservation Group	Markkleeberg		Cröbern		Zehmen		Other Sites		Total: All Sites	
	No.	%	No.	%	No.	%	No.	%	No.	%
1	55	2	11	11	40	12.5	2	4	108	3
2a	1,796	67	12	12	91	28.5	17	37	1,918	61
2b	835	31	76	77	188	59	27	59	1,126	36
Total	2,686	100	99	100	319	100	46	100	3,152	100

Group *2b* (*cf.* fig. 13, p. 539) comprises a great variety of tools of a very different degree of rolling. Some pieces show only slight polishing and a shiny, greasy patina, while at the other extreme are pieces whose edges are completely rounded by rolling and do not display any original marks, such as artificial notching or retouch. Some of the strongly rolled pieces have a white patination which begins at the edges. In general it is likely that among the pieces which have been assigned to Preservation Group *2b* there are also some older specimens which by chance always lay in the river bed, and hence were not subject to weathering by the air.

With respect to these three preservation groups, the totals of artifacts have been computed (table 3) for the different localities.

Table 3 clearly shows the fundamental importance of the site of Markkleeberg. Of the total series, it has furnished 2,686 pieces. Of course, this is partly due to the large extent of Pit *Md*, and to the long period during which collecting took place here. In the main, however, this wealth of finds is believed to reflect the fact that near this site there were workshops, the material from which was incorporated into the gravel. For this reason the portion of unrolled pieces is very high; the total amounts to 67 per cent of the entire collection from the Markkleeberg sites.

Next to Markkleeberg, Zehmen has supplied the greatest number of tools. In this respect, it must be recalled that here collecting only began a short time ago and exploitation has taken place on a relatively small scale. At Zehmen artifacts were also being manufactured, but here their portion is only 28.5 per cent of the total, which is much smaller than the ratio at Markkleeberg. Correspondingly, the proportion of rolled pieces (almost 59 per cent) and that of the white patinated pieces (more than 12 per cent) are much higher than at Markkleeberg.

The proportion at Cröbern, where only 12 pieces out of 99 were made at the locality, is even lower. On the other hand, the proportion of the rolled pieces is 77 per cent and that of the older, porcelain-like tools is 11 per cent. Taking the average of Cröbern and Zehmen, the ratio of the two groups, 2b and 1, is 6 to 1, which may be regarded as the average value for the Pleisse gravel south of Leipzig.

Although the pieces belonging to Preservation Group 1 constitute only little more than 3 per cent of the total finds from all localities, this value is not significant. Whereas at Cröbern and Zehmen the proportion of these pieces is approximately the same, that is 11 per cent and 12.5 per cent, respectively, at Markkleeberg it is only 2 per cent of the total finds. In comparison with the proportion of pieces in Preservation Group *2b*, it is also low. Since out of the much larger pit *Md* one would expect many more of the older pieces, it seems probable that at Markkleeberg very little attention was paid to these old, heavily weathered, inconspicuous specimens. Particularly during the first decades, all collectors sought out the beautiful fresh pieces, especially the blades. Some years later, however, after white patinated pieces had been found at Cröbern and Zehmen, these were also searched for at Markkleeberg. For this reason such pieces are almost completely lacking in the older collections. Thus the proportion of 2 per cent of the older pieces computed for Markkleeberg is based on the finds, but is not considered to represent the true proportion of those tools, which is believed to be higher.

By plotting these proportional values on an equilateral triangle (fig. 14, p. 540) a striking picture is given of the proportion of the various preservation groups at the individual sites. The values for the fresh pieces made at the site are plotted from the base upwards. This clearly shows the importance of the Markkleeberg locality as a workshop. Moreover, its large total in the *2a* category brings the point for all the sites combined (*T*) rather far up. On the other hand the points for Zehmen and Cröbern, where mainly rolled pieces were collected, lie far below and to the left.

In conclusion it should be emphasized that the three preservation groups distinguished in this report are not the same as the three stages which Jacob-Friesen (1914: 12) recognized. His classification was made

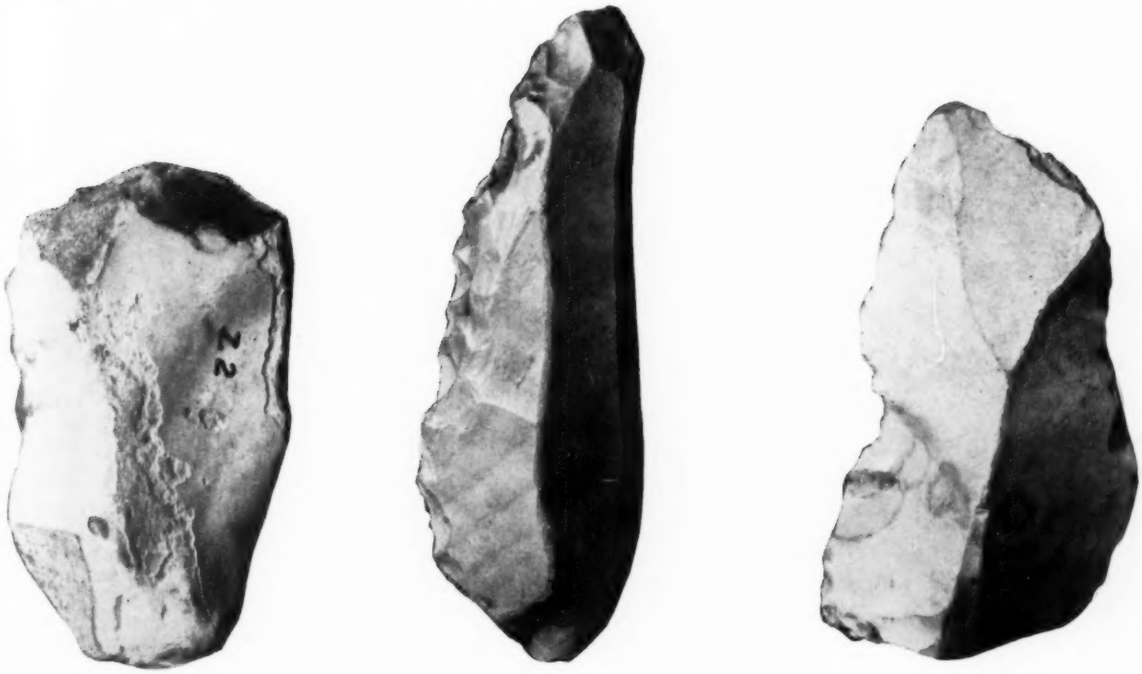
FIG. 11. Rolled and Thick Porcelain-like Patinated Flint Implements. Preservation Group 1.

1. A flake-blade of grey flint, rolled, and heavily patinated with a porcelain-like yellowish white patina (*cf.* fig. 21, no. 4).

2. Zehmen. A thick flake of grey-brown flint, heavily patinated a porcelain white, and heavily rolled. Subsequently the patinated edges have again been rolled and scoured. Nodular cortex is visible on the upper surface on the left distal end and at the left rear (*cf.* fig. 22, no. 8).

3. Zehmen. A retouched blade of banded, grey flint, rolled and with a thick, porcelain-like yellowish patina, which was later colored slightly yellowish (*cf.* fig. 21, no. 8).

4. A pointed biface of flint, heavily rolled, with a porcelain-like white patina, which was later colored ochreous brown. Both edges are worked in several steps. The upper surface shows some nodular cortex. The rear end consists only of natural fracture surfaces. The right edge (in the left illustration) is straight, the left is less well prepared. Only the distal edge of the lower surface has been preserved, the middle and rear sections having been lost as the result of frost action prior to patination. This specimen has been described previously by Werth (1928: 411).



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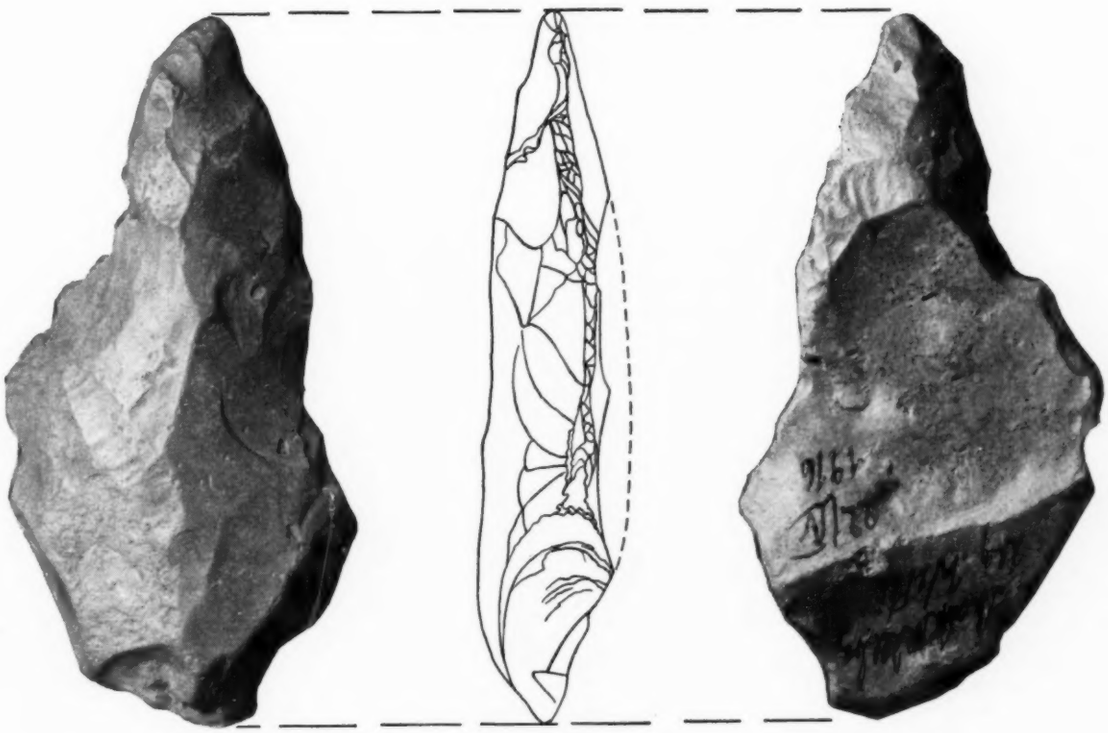

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FIG. 11

under the influence of Breuil, Commont, and Obermaier and was based on the concept that state of preservation and stage of cultural development were completely parallel.[1]

3. THE STONE-WORKING TECHNIQUES OF THE LEIPZIG LOCALITIES

a. MANUFACTURE OF FLAKES

The major portion of the archaeological material from the Leipzig localities consists of flake implements definitely of human origin. Only such pieces are discussed in this paper.

Many of the specimens have been manufactured by the anvil technique; they exhibit a large striking-platform, an open striking angle, a cone of percussion, and a large bulb (*cf.* fig. 15, p. 541). The large crude pieces struck off directly from the raw flint nodules show these features almost without exception. Frequently they exhibit portions of the original nodular ridges. Hence the primary flaking of the large nodules which were collected on the banks of the river was executed by dropping or striking them against a stone anvil, and many of the smaller pieces also appear to have been produced in the same manner. This has been described as the Clactonian technique.

In addition to pieces revealing the anvil method of production, we find many others exhibiting a less characteristic type of primary flaking. On the average these pieces are less crude, the striking base is often not as large, the striking angle approaches 90° or even attains this angle, the clearly defined cone of percussion is small, and the bulb is also small. Very probably these pieces were detached from the core with a hammerstone. By this method the blow was effected by hitting two hard objects against one another, a technique that corresponds to one of those employed during the Acheulian. Undoubtedly the hammerstone method represents a development from the anvil technique, but it is not always possible to determine whether a given specimen was made on the anvil or with a hammerstone. Therefore, it is advisable to include all flakes with the common features of these two flaking methods in one category and refer to them collectively as the "group produced by stone-on-stone technique."

Among the artifacts from Markkleeberg shown by Jacob-Friesen a few pieces are shown with a cone of percussion that was caused by the stone-on-stone technique (compare Jacob-Friesen, 1911: fig. 4, nos. 1 and 2). The same holds for the broad, crude flake later reproduced by Jacob-Friesen (1914) in figure 3, which also shows the open striking angle characteristic of this flaking method. Commont has referred to this flake as of "markedly archaic type" in discussion with Jacob-Friesen; concerning this and other Clactonian-type flakes from Central Germany, I have previously reported (Grahmann, 1939). The same types of tools from the Markkleeberg collections described in the present report include crude flakes, crude tools, blades, and points. A typical series is shown in figures 12 and 21–33.

In addition to the group produced by the stone-on-stone technique, there is a series which was probably manufactured by striking with the cannon bone of a large animal, inasmuch as it is unlikely that wooden clubs were available owing to the prevailing climatic conditions. Such flakes produced by the "billet" or "soft blow" technique do not exhibit a cone of percussion but only a flat bulbar protuberance, almost always with a small flat scar splintering off to one side. In general the striking angle varies between 90° and 100°, but sometimes it is more obtuse. Many pieces in this category have butts that are faceted in characteristic Levalloisian fashion. This feature has already been shown in figures 22, 24, 27, 28, 59, 62, and 64 repro-

FIG. 12. Unrolled Implements of Flint and Quartzite. Preservation Group *2a*.

1. A narrow blade of patinated grey-brown flint which is angular and unrolled. It is pointed and single-ribbed, with over-all indentations along both edges, predominantly on the lower surface. It has been described by Jacob-Friesen (1914: fig. 45).

2. A blade of grey-black flint, still partly covered with grey cortex but otherwise almost unpatinated, with sharp, translucent edges. It has a plain striking-platform, a striking angle of 110°, a short cone and bulb, and unretouched edges.

3. A point of spotty, grey flint with an olive-colored patina. It is angular and unrolled with a large, slightly faceted striking-platform, a very thick bulb of percussion, two longitudinal ribs on the upper surface, and a few indentations along the edges.

4. A blade of light grey flint, only slightly patinated, translucent at the edges, angular and unrolled. It has a small, plain striking-platform, a striking angle of 100°, a short cone and bulb of percussion. Both edges show indentations resulting from use.

5. A retouched, thick blade of translucent, dark grey flint, scarcely patinated, and unrolled. The upper surface exhibits nodular cortex at the rear and surface preparation on the left. The left edge shows steep retouching which forms three shallow indentations. The right edge exhibits over-all short retouching.

6. An unworked flake-blade, with a single rib, made of very fine-grained fresh-water quartzite of the Lower Tertiary Period.

[1] Such an assumption is understandable considering the circumstances under which many of the French artifacts have been found. Particularly at the classic French sites (compare Breuil, 1939), there are stratified deposits representing several Pleistocene stages: e.g., those of the Würm Glaciation, of the Last Interglacial and the Riss Glaciation, and sometimes even older ones. The individual deposits developed differently, and hence weathering occurred in them in several ways. Therefore, the tools which were lying in these beds exhibit different states of preservation. Since we have to deal with layers of rather different age, these are certainly examples of different techniques which may be attributed to corresponding cultural stages. If one is familiar with the collector's experience and the state of preservation of the pieces of each geological layer found in a pit, one may classify as to geologic horizon other finds from the same pit on the basis of their patina, even if they have not been taken out of the section or otherwise obtained by *in situ* collection.

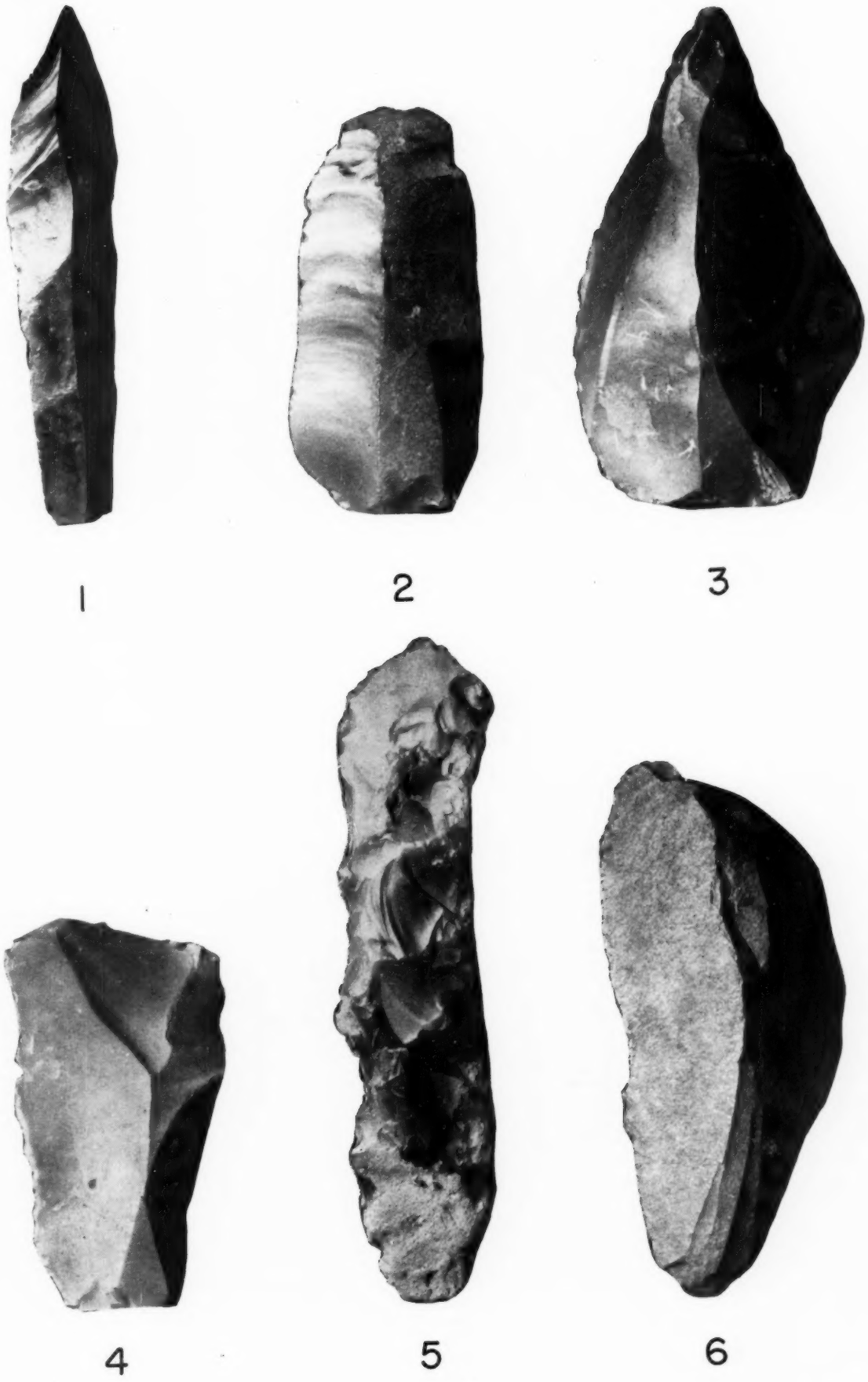


FIG. 12

TABLE 4

MARKKLEEBERG

Technique	Preservation Group					
	1		2a		2b	
	Number	%	Number	%	Number	%
Plain striking-platform; stone-on-stone	22	78	437	34	171	35
Plain striking-platform; bone billet	6	22	508	39	240	49
Faceted striking-platform; bone billet	—	—	358	27	79	16
Total	28	100	1,303	100	490	100

TABLE 5

CRÖBERN

Technique	Preservation Group					
	1		2a		2b	
	Number	%	Number	%	Number	%
Plain striking-platform; stone-on-stone	4	50	3	25	14	28
Plain striking-platform; bone billet	4	50	7	58	29	58
Faceted striking-platform; bone billet	—	—	2	17	7	14
Total	8	100	12	100	50	100

duced by Jacob-Friesen (1914). In fact he even speaks of basal retouch, and for this reason Breuil and Koslowski (1934: 266) have attributed the material from Markkleeberg to the Levalloisian, which is only true for a part of the total series. Still other pieces exhibit all the features of the billet technique except for the butt, which is unfaceted. Conversely, in rare instances specimens occur that exhibit faceted butts, but which have been struck by the stone-on-stone technique.

Finally we should mention a small group with very thin or even pointed butts. In many cases the striking platform is actually lacking, whereas the flat bulbar protuberance reminds one very much of the pieces in the preceding group. These are mostly very thin, small to medium-sized flakes and blades. Possibly these too were detached with a bone billet, but it may well be that here we are dealing with the earliest use of pressure flaking with a stone or bone punch as is found in Upper Palaeolithic assemblages. Since this matter cannot be decided with certainty, however, we shall include these pieces with those of the preceding group.

On the basis of the technique of manufacture, the following groups may be distinguished:

1. Plain striking-platform and stone-on-stone technique.
2. Plain striking-platform and billet technique.
3. Faceted striking-platform and billet technique.

In so far as these characteristics can be recognized, the following tables show how the pieces referable to the various groups are distributed with respect to the localities and the three preservation groups defined on page 533 of this paper.

The results of a comparison of the material from the various sites on the basis of the above tables, as well as those reproduced on page 540, may be summarized as follows:

In Preservation Group *2a*, which includes the pieces made on the spot, the proportion of the stone-on-stone technique at Markkleeberg, Cröbern and Zehmen varies between 25 and 34 per cent; at the miscellaneous sites it is 50 per cent, but this is obviously a chance value which results from the small number of finds. Among the pieces manufactured by the bone billet technique, those with faceted striking-platforms are always in the minority. This latter feature occurs more frequently on the large, well-made flakes of all types than in the case of the small ones. Thus it is represented in the collection from Markkleeberg by a figure of 27 per cent, whereas the proportion in Zehmen and Cröbern is only 11 per cent and 17 per cent, respectively. On the other hand, the proportion of pieces made by the bone billet technique with unfaceted striking-platform

FIG. 13. Rolled Implements of Flint. Preservation Group *2b*.

1. A narrow blade of flint, patinated light brown, and slightly rolled. It has a very small striking-platform, a small bulb of percussion, a single rib, and a slightly curved lower surface with indentations along both edges. It has been described and illustrated previously by Jacob-Friesen (1914: fig. 19).

2. A flake-blade of spotty, dark grey flint, heavily patinated, and heavily rolled. Nodular cortex is visible on part of the upper surface. It has a faceted striking-platform which lies at a right angle to the long axis. Both edges exhibit many indentations and traces of rolling.

3. Zehmen. A left side-scraper with an awl point, of milky blue to grey slate-colored flint, patinated and heavily rolled. It retains an area of nodular cortex, and is made from a thick flake with the point of impact on the right in the rear.

4. An oval flake of flint, heavily patinated an ochreous yellow to brown, and heavily rolled (*cf.* fig. 51, no. 9).

5. A broad blade of flint, heavily rolled, with a deep olive patina. It has a small, plain striking-platform, a striking angle of 105°, and a short bulb of percussion. The upper surface exhibits several flake scars. The distal and left edges are steep and blunt, while the right edge shows an over-all retouch.

6. A narrow, retouched blade of flint, rolled, with a thick brown patina. The upper surface is partly covered with rust (*cf.* fig. 46, no. 9).

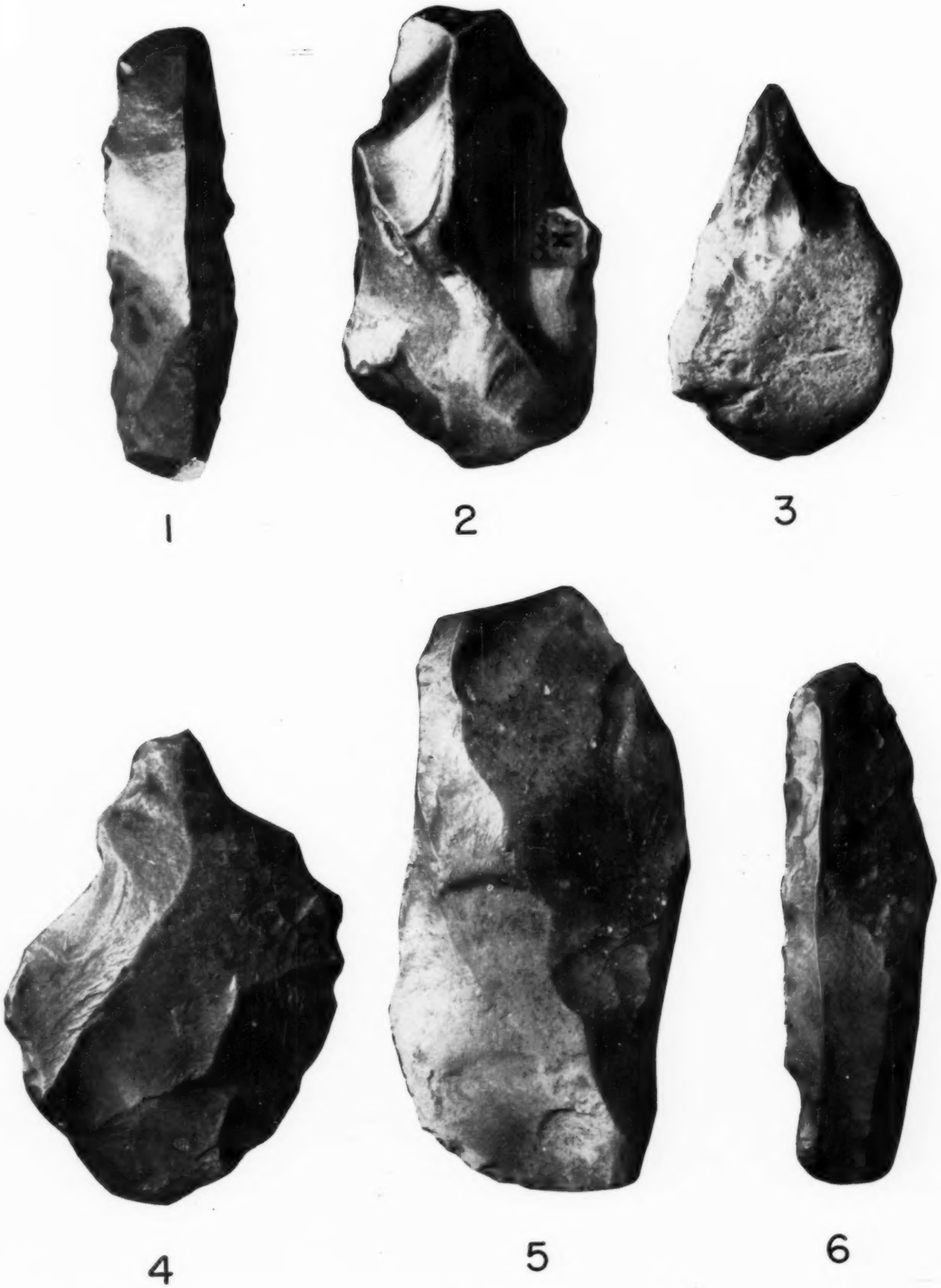


FIG. 13

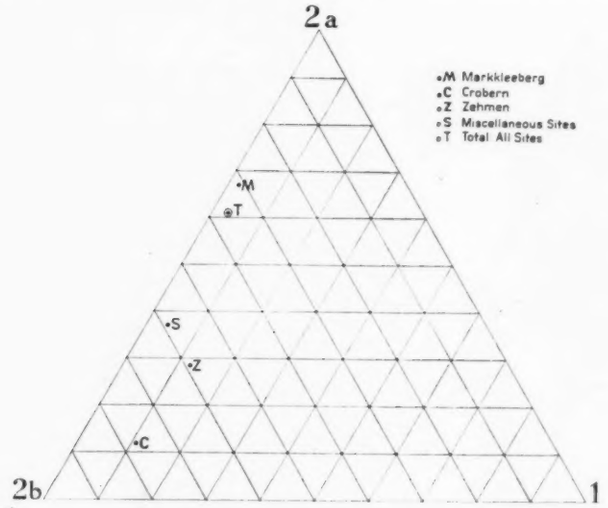


FIG. 14. Triangle diagram for Preservation Groups found at the Leipzig sites.

is smaller (39 per cent) at Markkleeberg than at Cröbern and Zehmen where it is 58 to 60 per cent. Among these pieces there are also some lacking a platform; which were possibly pressed off, thereby revealing a rather progressive flaking method. In Preservation Group *2b*, the group of rolled pieces of about the same age as the gravel, the proportion with respect to the technique of manufacture is about the same as at the miscellaneous sites. The frequency of the pieces made by the stone-on-stone method varies between 24 and 35 per cent; that of the pieces produced by the billet technique, either with plain striking-platforms or lacking this feature, between 49 and 61 per cent; and that of specimens with faceted butts between 14 and 20 per cent.

The over-all values from the series as a whole are expressed in table 8. This shows that the percentage values for the rolled pieces in the series as a whole is very similar to those for Markkleeberg alone. Furthermore, the percentage values for Cröbern, and particularly those for Zehmen, differ only slightly. Hence we may take this as a mean value for the Riss glacial gravels of the Pleisse near Leipzig. On the other hand, the site of Markkleeberg is characterized by different percentage values with respect to the pieces made on the spot, especially with respect to the greater proportion of flakes with faceted striking-platforms. If one takes these pieces into consideration and also those which were made at the other sites, the percentage figures are somewhat changed, as may be seen by the last column in table 8.

Finally with regard to the rolled pieces of Preservation Group 1, which are believed to be older, we observe a greater proportion of pieces made by the stone-on-stone technique at all sites. At Markkleeberg, Cröbern

TABLE 6

ZEHMEN

Technique	Preservation Group					
	1		2a		2b	
	Number	%	Number	%	Number	%
Plain striking-platform; stone-on-stone	15	48	19	29	34	30
Plain striking-platform; bone billet	13	42	39	60	56	50
Faceted striking-platform; bone billet	3	10	7	11	22	20
Total	31	100	65	100	112	100

TABLE 7

MISCELLANEOUS SITES

Technique	Preservation Group					
	1		2a		2b	
	Number	%	Number	%	Number	%
Plain striking-platform; stone-on-stone	1	100	5	50	3	24
Plain striking-platform; bone billet	—	—	3	30	8	61
Faceted striking-platform; bone billet	—	—	2	20	2	15
Total	1	100	10	100	13	100

TABLE 8

ALL SITES

Technique	Preservation Group					
	1		2b		2a+2b	
	Number	%	Number	%	Number	%
Plain striking-platform; stone-on-stone	42	62	222	33	686	33.4
Plain striking-platform; bone billet	23	34	333	50	890	43.3
Faceted striking-platform; bone billet	3	4	110	17	479	23.3
Total	68	100	665	100	2,055	100

FIG. 15.

1. A very large, unshaped, coarse flake of grey flint, unrolled, with a brownish patina. It weighs 3,014 gms. and measures up to 7.5 cms. in thickness. The striking-platform is large and broad, and the striking angle about 130°. The flint is broken around the pronounced striking cone next to which is a large, thick bulb of percussion. The upper surface shows flake scars from several previous heavy blows and part of the cortex of the flint block from which it was made. About half of the front edge has been steeply retouched in a simple fashion. The left edge shows retouching on the lower surface of the slight indentation at the rear. The specimen has, therefore, undoubtedly been used as an implement. It has been illustrated by Grahmann (1938*a*).

Similar, though not illustrated, is specimen S1 from Markkleeberg. It is also unrolled, is 21 cms. long, 22 cms. wide, up to 8.5 cms. thick, and weighs 3,180 gms. The extended front edge also exhibits fine steep retouching which runs around to the left edge. These two coarse flakes are the largest worked specimens found at Markkleeberg.

and Zehmen it varies from 48 to 78 per cent. Since this is presumably the more primitive technique, this fact supports the argument for the higher age of this group. The same observation applies to the small proportion of pieces exhibiting faceted striking-platforms, which thus far have only been found at Zehmen. For all the pieces together the values may be seen in table 8.

A conspicuous result of the proportional analysis of the three principal flaking methods is given by plotting the percentages on an equilateral triangle (fig. 16, p. 542). In this the values for the pieces made by the most developed flaking method (i.e., those with faceted striking-platforms and billet technique) are plotted from the base of the triangle toward the apex. The values for the pieces with plain butts and billet technique are plotted from the right side towards the left corner, and those for the specimens produced by the stone-on-stone method from the left side to the right corner. This method of presentation is intended to express the gradual upward development towards a theoretical stage of technological development characterized by pieces that all possess faceted striking-platforms, which occupy the apex of the triangle. Thus the higher a point lies on the triangle, the greater the frequency with which this technique occurs. In general, the farther upward to left the point falls, the higher the proportion of the billet technique, whereas the right corner is reserved

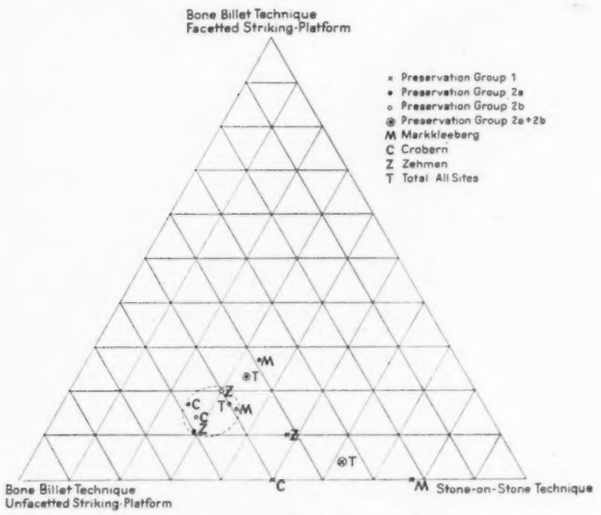


FIG. 16. Triangle diagram for the Flaking Techniques found at the Leipzig sites.

for the pieces produced by the stone-on-stone method, that is, those pieces which have affinities with both the Clactonian and with the Acheulian.

The point for the material in Preservation Group *2a* from Markkleeberg lies highest, which indicates a higher proportion of the more advanced flaking technique. On the other hand, of the pieces from Cröbern and Zehmen examples with unfaceted butts are predominant; therefore the points are farther to the left and lower down. All points for the rolled pieces are near each other, which is to be expected inasmuch as they represent a mean value for the Riss glacial gravels. Here one may designate an area within the triangle which includes the plots for the frequencies of the pieces from Cröbern and Zehmen.

The points for the few specimens belonging to Preservation Group 1 are located in a quite different sector. On account of the high proportion of stone-on-stone technique, they move farther to the right and maintain a position near the base of the triangle, since examples with faceted striking-platforms are very rare. In this manner a less evolved flaking technique is clearly shown indicating a greater age for this series. For it seems probable that during the Mindel-Riss Interglacial the stone-on-stone flaking method still predominated in Central Germany. But by early Riss times two-thirds of the pieces were already being manufactured by the billet technique. The faceting of the striking-platform necessary to obtain large flakes is found as the highest technical stage of development of the Riss Glacial Period, particularly at the workshops in the Markkleeberg area. We must assume that the direct percussion method was used at the same time, not only because of the type of raw material available, but also to enable the artificer to produce the desired type of flake. A cannon bone or even a wooden club was certainly not always at his disposal so that it was often necessary for him to employ a hammerstone. The primary preparation of the flint nodules probably still took place on an anvil or with another stone, and for the further working of the tools several additional techniques were used at the same time. Furthermore, the various hordes differed in skill; particularly skillful, however, were those who worked at Markkleeberg, a fact which is also revealed by other archaeological material from this same region.

b. SECONDARY WORKING

Notwithstanding careful core preparation and flaking technique, the resulting piece did not suffice for the desired purpose in all instances, and it had to be further shaped by secondary working. This consists of the removal of portions of the flake either by chipping or breaking, as well as of indentation or retouching of the edges. With respect to the Markkleeberg material, the following types of secondary working may be distinguished: (i) Breaking or chipping off the corners of the piece; (ii) Thinning of the upper surface of the butt end of a piece possibly for the purpose of hafting; (iii) Striking off of a thumb rest on the back side of the flake; (iv) Oblique breaking off of the distal end of a blade in order to fashion a finger rest or a point; (v) "Graver" blows for the purpose of obtaining a point; (vi) Indenting or serrating of the edges; (vii) Single and double retouch of the edges; retouching of curvatures on awls and drills; and (viii) Protective retouching.

(i) On flakes of the Clactonian type, including points and very rarely blades (almost exclusively on pieces which were manufactured by the stone-on-stone technique), one of the corners was sometimes worked in an oblique manner (see figs. 28 and 29). In the majority of cases, it is the right corner which exhibits this treatment. The oblique striking-platform adjoins the lower surface at an obtuse angle, normally of 130° to 150°, and it is frequently slightly undulating. In figure 28, nos. 1 and 2, these features as seen from the lower surface of the piece are illustrated.

(ii) The basal portion of most of the flakes is thickened by the bulbar protuberance which is present at the butt end. Also in the case of many blades or points a ridge-like projection is present on the upper surface opposite the bulb, which causes further thickening. This makes grasping, and even more so the possibility of hafting, so difficult that the protuberances must be removed. The simplest way to achieve this is with a blow on the striking-platform more or less parallel to the long axis of the piece. This technique was particularly used in the case of thick flakes. Apparently this type of trimming flake was often detached prior to the removal of the piece from the core. (For examples see figs. 41, no. 11; 42, nos. 3, 5; 44, no. 16 and many others.)

Similar are the pieces with stepped flaking on the upper surface of which several thin chips ending in steps have been removed by short blows from the base. Jacob-Friesen (1914: 20) has already pointed this out, and he speaks of lamellar retouch. This type of reduction is sometimes found on points, suggesting the possibility that they were hafted, as is also the case with the blades.

Only rarely was the striking-platform of the flakes thinned by a strong blow or by retouching. This occurs in the case of blades, points, and scrapers, and it was sometimes very carefully executed, which is not unusual in the Lower Palaeolithic of Western Europe. The removal of the striking-platform has not been observed either in the case of blades or points. If this feature is lacking on scrapers, side-scrapers, or awls, it is because these tools were made either on broken portions of flakes or on natural fragments.

(iii) On some of the side-scrapers found at Markkleeberg, concavities were made on the lower surface by blows along one edge, which probably served as supports for the thumb (see figs. 65, nos. 4, 6; 66, nos. 2, 3). Such working was apparently very rare in the Lower Palaeolithic, and for comparative purposes in Germany one can only cite a scraper from Langenstein whose lower surface exhibits an indentation for the finger. But the geological age of this piece is not certain (compare Museum Pamphlet 11/12 of the Städtische Museum of Halberstadt, 1937 or before).

(iv) In order to obtain a support for the index finger, some flakes and flake blades were broken off obliquely, almost always from the pointed end (left) toward the base (right). In this manner an oblique-ended blade is produced (figs. 47, nos. 6–10 and 13; 48, nos. 1–6). Possibly it was used in the right hand as a cutting tool, unless this breaking off of the distal portion was for the purpose of fashioning a point.

(v) Very few of the Markkleeberg pieces exhibit the presence of "graver" blows which were struck away from the pointed end of the flakes (fig. 48, nos. 7, 13, 14). This working method is very unusual in the Lower Palaeolithic.

(vi) The majority of the Markkleeberg flakes displays indentations or serrations of the edges. In most cases these are found either exclusively on the upper surface or exclusively on the lower surface; therefore, they were made purposely in order to increase the cutting capacity of the edge. When the indentations are completely irregular and of different sizes, this is probably due to extensive use of the edge or to blows which occurred subsequently. If the indentations were made in a regular alternating manner from above or from below, one may speak of sawing. Intense indentation may be considered a transition to edge-retouch.

(vii) Edge-retouch is less frequent than simple indentation. One can distinguish a simple retouch which took place in a single working process, and a multiple retouch for which one or two working processes were necessary. The former is so similar to continuous, intense indentation that the dividing line between the two is often quite arbitrary. Multiple retouch is only rarely represented at the Markkleeberg sites. As in the case of indentation, it was probably always executed with a bone billet. The working of steep-scrapers (figs. 67 to 69) or flat side-scrapers (figs. 63–66) was done in this manner, and it is also rarely found on worked blades (figs. 46 and 47, nos. 2–4) and points (figs. 61–62). In only a few cases do the latter exhibit secondary working of the entire upper surface (see figs. 23, no. 4; 62, nos. 1–2, 4–7, 9).

Tools with indentations, as well as awls, borers, drills and similar implements (figs. 48, nos. 8–10; 61, nos. 1 and 4), are made by a technique of retouching the edges (compare also figs. 62 to 70).

(viii) Protective retouching is very seldom found in this series. It is relatively most frequent on side-scrapers, which were probably used in the same manner as the Eskimo women's knives (see figs. 63, nos. 9–10; 64 and 65).

4. TYPES OF IMPLEMENTS FROM THE LEIPZIG LOCALITIES

a. GENERAL REMARKS

In the Lower Palaeolithic the total range of tool types is somewhat limited. The major portion always consists of flakes of different types and techniques of manufacture. In comparison with these, the pieces made from cores and worked on both surfaces, the so-called coupe de poings, hand-axes, or "bifaces," play a minor role. This is even true if we speak of a hand-axe culture as contrasted to a flake or blade culture. In this connection, it is interesting to note that the most beautiful and perfectly shaped hand-axes were frequently not made on cores at all but on flakes.

At the Leipzig sites flake artifacts are by far the most numerous single category of tools. A large part of them have the shape of blades and next in importance are the points. Many flakes were worked into side-scrapers, end-scrapers, and awls or drills. But such pieces were also made on natural fragments of flint. Hand-axes are very rare.

On the basis of the foreging discussion it is apparent that some of the flakes from Markkleeberg exhibit more or less the distinctive features which are attributed to the Clactonian and Abbevillian assemblages; namely, a large striking-platform, an open striking angle, a clearly defined cone of percussion, and a pronounced bulb. But other pieces reveal, partly by virtue of their faceted striking-platforms, which are at an angle of 90° to 100°, and partly by virtue of the treatment of the upper surface before removal from the core, a close relationship to the Levalloisian. Whereas the former were produced by the stone-on-stone technique, a bone

billet was apparently employed to detach the latter. Still other specimens suggest relationships with the Acheulian of Western Europe.

These facts might induce us to arrange the entire series on the basis of these characteristics—i.e., to sort out the various "cultures" from the series as a whole and consider each of them separately. Undoubtedly this procedure would have certain advantages, but it assumes that such "cultures," each based on a distinctive technique for manufacturing stone implements, once existed in pure form at a given time horizon in the Leipzig region. Of course such an assumption is admissible, but it is unproven. The Pleisse River gravels contain in complete disorder the physical and imperishable remains of a given geological horizon without regard for objects of unique origin or those introduced by bearers of different "cultures." Although the latter alternative is the usual approach, it does not seem advisable to separate the collection as a whole according to "cultures," especially since such "cultures" in a pure form have never been demonstrated for the same period. This probably does not apply either to the Acheulian of Western Europe or to the Clactonian, but the latter is older at the type site. With respect to the Lower Levalloisian of Northern France and Belgium, it is apparent that it occurs either together with forms of the Acheulian or with those of the Clactonian. Since these finds also come from river gravels, the problem of a clear separation is just as uncertain here as it is in the Leipzig area.

This question is of basic importance, since it concerns the fundamental principles of the Palaeolithic classificatory system. How are these principles to be understood? There is no question that the tools contained in river gravels, even if they are geologically speaking monogenic and accumulated during a short interval of geologic time, must be evaluated differently from the materials found in camp sites and in primary occupation layers in caves, both of which furnish the imperishable remains of a single group or a sequence of generations of monogenic cultures. Therefore, in the Mousterian and in the Upper Palaeolithic one can evaluate the artifacts much more precisely in terms of specific assemblages than is possible in the Lower Palaeolithic where settlement sites are almost completely lacking. For contained in the river gravels there are only mixtures of tools, and we have absolutely no way of knowing which ones can be assigned to a given culture. Even in the classic field of Lower Palaeolithic archaeology, one has not always been certain concerning the correct procedure. Indeed the original classification considered only the hand-axes of the Lower Palaeolithic and neglected the points, scrapers, etc., made on flakes. The latter were regarded as significant only for the Mousterian. Later on, however, it was gradually demonstrated that these flake implements also appeared in direct association with the hand-axes of the Abbevillian and Acheulian, and, accordingly, it was suggested that here at the same time the Mousterian was also starting to develop—an incorrect view as we now know. The situation is similar in the Thames gravels of England where the Acheulian together with the Clactonian is apparently present. However, there is some justification for this because certain gravel layers contain exclusively Clactonian flakes.

Since at the Markkleeberg sites there is no stratification of the archaeological material, no sequence of stone-working techniques or "cultures" can be observed. On the contrary, experience tends to contradict the assumption that here such a layerwise distribution ever could have existed. Therefore, a separation of the artifacts into "culture groups" will be omitted in the following discussion. Moreover, any such breakdown would encounter serious difficulties for, although there are very typical representatives of the "pure cultures" at the Leipzig localities, one finds just as many transitional forms. Furthermore, in most of our groups of implements the manufacturing techniques of all the so-called "pure cultures" under consideration are present.

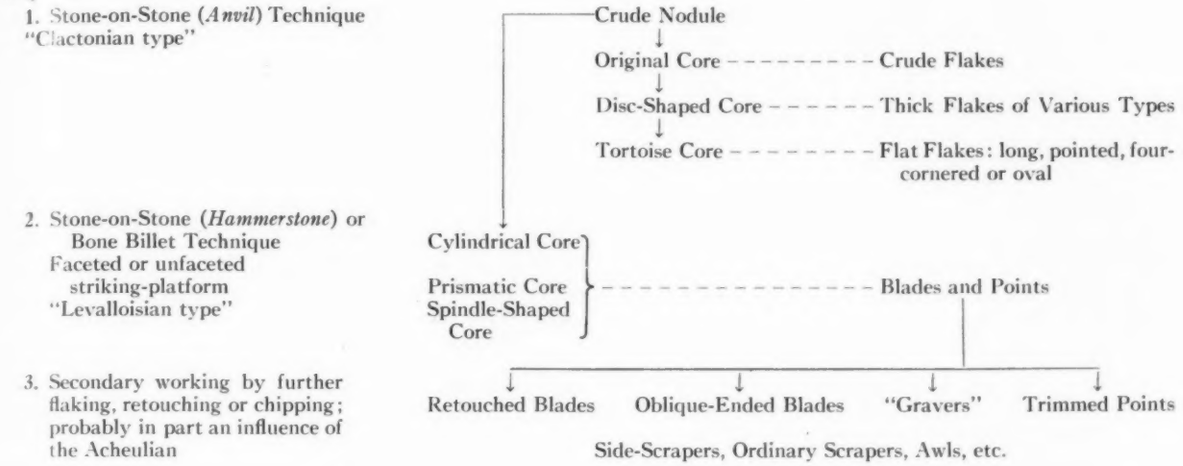
Therefore, we have classified our material on the basis of types of implements. Following their description and the very important matter of the establishment of their occurrence from a quantitative point of view, a discussion of the relation of the series as a whole to that from other sites and to the recognized stages of Lower Palaeolithic cultural development will be given.

The scarcity of Lower Palaeolithic finds in Germany and the complete lack of monographic description of a German Lower Palaeolithic site makes it inevitable that, in spite of the limited number of tool types, their designation and demarcation are uncertain and arbitrary. Definitions of types have not been made so far, and a survey of the professional literature reveals only confusion with regard to the nomenclature referring to the implements. Even concepts which one is led to accept as unequivocal and clear, such as hand-axes, flakes, blades, scrapers, side-scrapers, etc., are often applied in several different senses. Because of this situation, it has been deemed necessary to present, before the description of a particular piece, a general discussion of the various types of implements and at the same time to point to the peculiarities which are important with respect to the Markkleeberg series.

The initial point of departure in the manufacture of flint tools is the nodule in the majority of cases, either in original mint condition or rolled in the gravel. These nodules, which are derived from the ground moraines or from the fluvio-glacial formations of the Mindel Stage, were collected by the Lower Palaeolithic hunters on the river banks during 2nd Interglacial and Riss times. At first the raw material was probably predominantly worked by the anvil method or by means of direct percussion with a hammerstone, but sometimes

TABLE 9

GENETIC RELATIONSHIP OF THE STONE IMPLEMENTS FROM THE LEIPZIG LOCALITIES



also by a blow with a bone billet or a similar object. As a rule, the flakes produced by this procedure have not yet attained the desired shape; they are crude and of a more or less accidental form. These are described as "unprepared coarse flakes."

The effort to obtain flakes of a desired shape leads to the proper preparation and striking of the crude block: the nodule must be developed into a core. At first the latter exhibits such irregular forms as those illustrated by Breuil (1932*a*) from the Early Clactonian of Clacton-on-Sea. Such flakes detached on the anvil or with a hammerstone are short and thick, and little by little the core takes on some form of a disc. Although the shapes are intentional, frequently they cannot be assigned to the usual groups of tools, and for this reason they are designated as "prepared coarse flakes" in this paper.

The next stage of development indicates a tendency to make the flakes thinner and larger, that is with an edge which is as long as possible. This goal is achieved with the discovery of the planoconvex (tortoise), the cylindrical and the spindle-shaped cores. Thin, broad flake-blades and points are thus obtained. By additional secondary working on the flakes, oblique-ended blades, retouched blades, blades with awl- or graver-type points, as well as retouched points, are obtained. Finally ordinary scrapers, side-scrapers, and awls, which in some cases are also made from flint fragments, are produced. The hand-axes comprise a distinct category; these tools were made partly on cores or natural fragments and partly on flakes. On this basis we may set up table 9, showing types of tools made on flakes.

b. CORES

Figures 17 and 23, no. 7

Pieces of flint from which flakes have been struck are regarded as cores. Their origin is almost always a natural or rolled flint nodule. The very irregular or even bizarre shape of the latter frequently shows that the blow was struck in such a way as to produce a flake of desired shape. The remainder is designated a primary core, which can be further flaked in the same way.

In other instances the flint nodule has been prepared from the beginning as a regular core. The oldest form is the discoidal core which already appears in the Clactonian of the Mindel-Riss Interglacial and from which short, thick flakes, predominantly of the Clactonian type, are produced. It is the forerunner of the plano-convex tortoise core, the scars on the convex surface of which resemble the armor plates on the back of a tortoise.

In contrast to the discoidal core, whose upper and lower surfaces are treated in the same manner and are arched, the tortoise core has a strongly arched upper and a more or less flat lower side. The lower surface is prepared by blows from the sides that remove thin converging flakes which meet in the center. The problem now is to remove a flake from the prepared surface by a powerful and very skillful blow on the edge of the tortoise core, in such a manner that the diameter of the flake corresponds as far as possible with that of the core. In order to effect the blow with the necessary strength and certainty near the edge of the core, the latter was flattened by trimming on the upper surface. The flake exhibits this trimming, which is called a faceted striking-platform, and the flake scars on the arched lower side of the tortoise core correspond with the convergent flaking on the upper surface of the flake of Levalloisian type. This flake is usually broad; consequently after its removal the lower side of the core consists of a *single,* slightly concave surface, but further convergent flaking from the edge of the core will lead to the production of additional flakes. In any case, there are tortoise cores not only with a lower surface

that exhibits the scars of centrally-directed flakes, but also examples with a single large scar on the lower surface made by detaching a single Levalloisian-type flake.

Another method of producing flakes consists of selecting cylindrical-shaped flint nodules of round or oval cross-section and detaching flakes directly from the convex surface. The first flakes struck from such cylindrical or prismatic cores exhibit on the upper surface areas of the original crust or cortex of the nodule. The blows were partly by the stone-on-stone and partly by the bone billet technique. In the latter case, the striking-platform of the core has sometimes been trimmed along the edge, as in the case of the tortoise cores, so that flakes with faceted butts were often obtained in this manner. The reduction of the cylindrical-shaped nodules takes place partly from one side, and partly from both sides until only a thin prism remains.

Closely related to the cylindrical cores are the spindle-shaped cores. They probably develop in the following manner: the detached flakes are given a strong, hollow curvature of the lower surface so that the original cylindrical core at first acquires the form of a bulging barrel, and later that of a spindle. The quality of the raw material and the flaking method must be united when this technique is used. The spindle-shaped cores are also reduced until they become thin rods.

Almost all the cores come from Markkleeberg. The greater part of them are unrolled, which again proves that the factory sites were located here. Most frequent are scarred primary cores which sometimes display remains of the cortex and the scars of the various types of flakes and flake-blades that have been removed. All the flaking methods described above are represented. The preparation of the striking-platform can be observed at times on such irregularly formed and only partially reduced cores.

Discoidal cores are very rare at the Leipzig sites; actually only one piece (fig. 17, no. 3) belongs with certainty to this category. A beautiful large discoidal core found in the Elster-Mulde gravel of Bitterfeld, likewise of Riss age, is in the Schulte Collection.

Tortoise cores are more frequent, although only a few of them are of regular form. The piece illustrated in figure 17, no. 2 has been previously described (Grahmann, 1938*c*). At that time I considered it the first tortoise core found in Germany, and actually it was the first to be so recognized. But it has been pointed out that Jacob-Friesen (1914: fig. 1) published a core which must be considered as a tortoise core. Like the above-mentioned core, the latter shows a polyhedric lower surface, so that the flake which was detached from this core would have been a genuine Levallois flake with converging flake scars on the upper surface. In contrast to these cores, the piece illustrated in figure 23, no. 7 shows the scars of several flakes which were struck from it. In this instance further working would result in the production of long blades with a longitudinal rib. In a sense this core forms a transition between the tortoise and cylindrical cores.

In figure 17, no. 1 an example of a cylindrical core with an elliptical cross-section is illustrated. Here the blows have been delivered from both ends, thereby producing blades and blade-points.

In addition to the cores illustrated in this report there are some of much smaller size. This holds true in the case of the spindle-shaped examples which are usually closely related to the cylindrical cores; of these scarcely anything remains except for reduced prisms and rods. However, Jacob-Friesen (1914: fig. 37) shows a very large spindle-shaped core which allegedly was found in Pit *Me*. Jacob-Friesen states with some surprise that from this core blades more than 20 cm. long had been detached. But blades of this type, which according to the form of this core should be curved over their entire length, have so far not been found among the more than 1,000 flake-blades in the present series. On this basis one may doubt whether this core really comes from the Riss gravels of the Pleisse River. However, the state of its preservation corresponds completely with the other flints from Markkleeberg.

c. COARSE FLAKES

Figures 15; 21, nos. 1–4; 23, no. 5; 24–32

As discussed above, a part of the present material cannot be arranged in the usual categories of implements. This applies to the flakes of simple, crude type, which are mostly thick and compact. Therefore they are simply referred to as coarse flakes. Many of them do not exhibit a predetermined shape and these are referred to as "unprepared coarse flakes." Others, on the other hand, distinctly show preparation of the core prior to detachment, as well as an unmistakable method of striking for the purpose of obtaining a certain specific

FIG. 17.

1. A cylindrical core of spotty, grey flint, partly patinated brown, almost unrolled and shiny. For the production of the core a cylindrical flint fragment of elliptical cross-section was used. The end surfaces of this specimen have a white patina. Flakes were struck alternately from each end; thus the striking-platforms were prepared by short retouch, and the blades or pointed blades produced would have had faceted striking-platforms.

2. A tortoise core of grey flint, patinated ochreous brown and unrolled. Part of the original, probably almost oval, core was broken off in antiquity. The surface illustrated shows flake scars made by the removal of flakes from the edge in the preparation of the core, as well as scars made by the removal of two long blades. The opposite surface shows only nodular cortex and flaking around the edge. The cutting edge of the core is flatly curved and occasionally retouched.

3. An unrolled discoidal core of grey flint with a light olive patina. Flakes have been removed by short blows directed from the edge toward the center on both upper and lower surfaces. The edge, seen from the side, makes a zig-zagging but almost straight line.

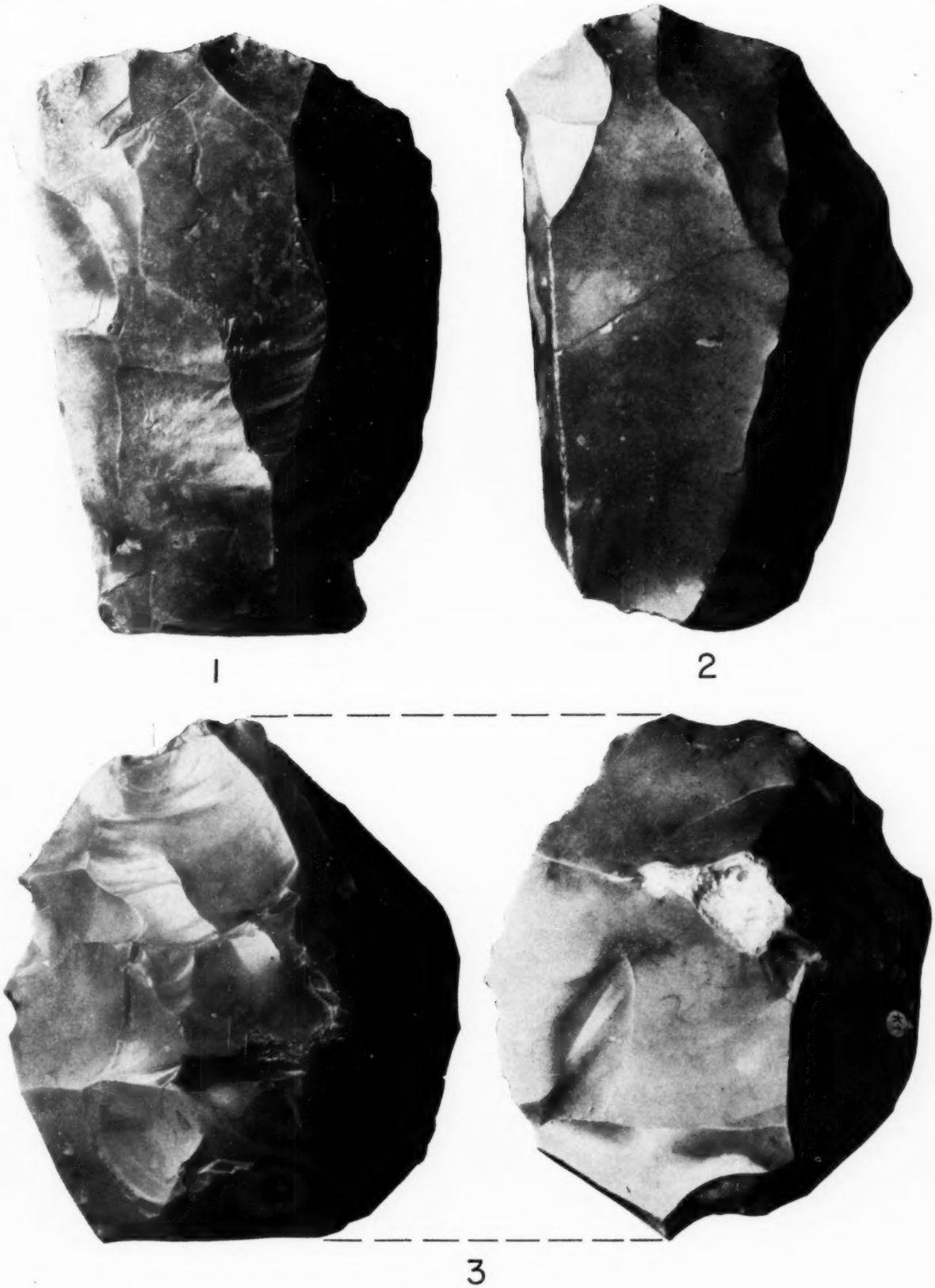


FIG. 17

shape. Furthermore, simple secondary working of such "prepared coarse flakes" reveals that they may be regarded as true implements. They are of different shape and are broadly grouped in the following discussion as "prepared coarse flake implements."

(1) *Unprepared Coarse Flakes*

As unprepared coarse flakes of no special form, we refer to pieces which exhibit clear marks of percussion without showing any characteristics of having a predetermined form. In the overwhelming majority of cases these were produced by the stone-on-stone technique—perhaps with a hammerstone, but more frequently on an anvil. In the latter case the striking-platform is often very large, but it may also be small, particularly when the blow was struck directly on the surface of the nodule. The striking angle may reach 135°; but flakes with such very open angles are not frequent. On the average the angle is 110° to 120°, or even less. Unworked coarse flakes of no special form which have been struck with bone billets are very rare. In this case they do not exhibit a cone of percussion, but only thick bulbs, and are generally smaller.

To the upper surface of many unprepared coarse flakes remains of the original crust or cortex of the flint nodule, which was either fresh or rolled in the gravel, still adhere. Objects in this category reveal no consistency as to form and can only be described as coarse, irregular flakes. On the upper surface of some specimens there are flake scars resulting from previous working, but even these examples are thick and coarse.

Although it is apparent that all these pieces are of human origin, one would be justified in doubting whether they are implements or only trimming flakes which were removed by the primary blows on large flint nodules, or whether they represent partially-completed pieces. But whenever these crude flakes exhibit a regular indentation, or even steep retouch in some instances, there can be no doubt that they were used for cutting or scraping; but on the basis of their form they cannot be regarded as belonging to one of the recognized groups of implements. There is evidence that the makers of the Markkleeberg tools, lacking a specific form, sometimes also used crude flakes as implements, even though these did not possess a useful cutting edge which occasionally could be worked a little further.

Most of the unprepared coarse flakes are large—sometimes larger than a hand. The largest pieces weigh more than 6 pounds, and one of the heaviest is illustrated in figure 15. Although it appears quite unmanageable, the indentation of some of the edges nevertheless reveals that these artifacts were used. Other coarse flakes (figs. 23, no. 5, and 24, no. 1) have been used as tools, as shown by the deliberate notching of the edges, but many other pieces lack such marks. Most of the unprepared coarse flakes are longest in the direction of the blow, but transverse pieces are by no means rare. Because of the great variety of these irregular forms and the size of many of the pieces, only a relatively limited range of types can be illustrated.

(2) *Prepared Coarse Flake Implements*

As stated above, some of the unprepared coarse flakes were used as implements, especially if their accidentally developed form was convenient and provided a cutting edge. In marked contrast to such chance implements are the crude flakes which apparently exhibit a predetermined form and were purposely struck as tools. These are called prepared coarse flake implements, although their form frequently does not correspond with that of recognized categories of tools or implements. It appears that many different methods were attempted before certain ones were perfected which required a relatively short time to produce the most useful implements. Hence, on account of their thin, sometimes crude shape, many pieces cannot be assigned to one of the groups of recognized tool types, but owing to the repeated occurrence of one and the same forms, it must be concluded that they were purposely produced.

Without exception all the coarse tools were struck with hammerstones or on the anvil; therefore, they are characterized by the corresponding features: a relatively large striking-platform, an open striking angle, a cone of percussion and a pronounced bulb. During the process of detaching flakes, the size of the core was reduced from all sides, partly in an irregular manner, as in the case of no. 2 in figure 1 published by Breuil (1932*a*), which comes from Clacton-on-Sea, partly in such a way that a thick disc-like form was developed; an example of this latter is shown in figure 17, no. 3. This core is very similar to those illustrated by Breuil (1932*a*) as nos. 45 and 46 in figure 6, also from Clacton-on-Sea.

The form of the flakes which result from this method varies very much. Some may be regarded as blades or points and will be discussed under their appropriate headings. However, most of them constitute a special group of implements of various types. Among these certain basic forms may be distinguished, i.e., rectangles, triangles, and ovals, although examples that are transitional between all of them may also be found. On a number of the prepared coarse implements, particularly on those basically of triangular form, one of the rear corners was obliquely struck off; in this manner the original large striking-platform was reduced, sometimes to a small remainder (compare section 3*b* above). In most of the cases by far, it is the right corner that is so removed, only seldom the left one. The question as to the purpose of this flaking technique is closely related to the problem of whether the detachment of the corner was executed on the finished piece, or whether the striking-platform was already made oblique on the core. In most cases the blow necessary for this purpose was made with a hammerstone. This fact is indicated by

the form of the oblique surface, which frequently also shows concentric ripple marks and sometimes a negative bulb of percussion. Judging by these features, the oblique blow was never struck from the lower surface of the piece, but always from its upper side. Hence the force could also have been applied prior to detachment from the core. But on some pieces the oblique surface truncates the striking cone, which developed when the flake was removed; hence it is obvious that the object was made oblique later, and that this process was part of the flake's further preparation. Probably the oblique surface was used as a support for the index finger in a similar way as is also to be assumed with respect to the oblique-ended blades. The blow which produced the oblique surface has so far not been observed on tools of Preservation Group 1, which is possibly more than due to chance.

Notwithstanding the fact that in the case of the coarse tools the blow was struck in such a way that a simple, predetermined form was approximately achieved, almost all the work of preparation on the core prior to detachment is incomplete. Only in a few instances has an attempt been made to remove irregularities in the form by careful secondary work, unless one regards as an example of such work the above-mentioned process of making the surface oblique. Subsequent flaking of the surface can hardly ever be observed. On the other hand, as previously stated, these flakes almost always display a superficial working of the cutting edge. In the majority of instances, this preparation was carried out by indentation, although sometimes one may observe only simple edge trimming, mostly on the upper side. These features prove that we are dealing with genuine implements.

It is not always easy to determine whether a coarse flake is of accidental or predetermined form, and this is particularly true because the latter are often very large, as is shown on figure 24, nos. 2–3. With their quadrangular form, they represent pieces that are transitional to the quadrangular flakes and, as in the case of examples from Preservation Group 1 (fig. 21, nos. 1–4), or of those dating from the Riss Glaciation (fig. 25, and others), they recall the flake which Leakey (1934: 108, fig. 10) illustrates as a typical example of Clactonian I. Nearly all show preparation of the edge by indentation or simple trimming. Other quadrangular flakes are broader than they are long, so that the transverse cutting edge is the most important one, for example as in the case of the pieces shown in figures 26, no. 3; 27, nos. 1, 3, 4.

In addition to the quadrangular pieces, those of triangular form, as well as the few that are of pentagonal outline, should be mentioned. Examples of pentagonal flakes are figured in figure 27, nos. 6 and 7. The former is also characterized by the fact that the rear corner on the right side has been removed. This method was used rather frequently on triangular flakes, as is shown by the examples in figures 28; and 29, nos. 1–4. Most of these triangular pieces exhibit a marked ridge, which does not extend to the point of impact but goes off to the right of it. This may be seen on the flakes illustrated in figure 29, nos. 1–4, which have a pseudo-platform with a midrib formed by the removal of the proximal portion of the right side. The triangular flakes are almost always coarse and heavy. They constitute a special category of implements, but some of them are so long that, notwithstanding their considerable thickness, they suggest pointed forms that are transitional to the thick points, such as the pieces in figure 29, nos. 5–8.

Thinner flakes, such as those illustrated in figure 32, nos. 1–3, usually display a less obtuse striking angle. They can be regarded as simple blades and presumably they served as such. The long flakes in figure 30 can likewise be denoted as essentially blades.

The flakes of round, oval, or pointed oval form constitute a special group. They have been struck from ball-shaped flint nodules. If the blow is delivered directly on the cortex, the pieces naturally have no striking-platform. But the pronounced cone and bulb of percussion which is associated with the cone and often extends over the entire lower surface of the piece, indicate that these specimens belong to the group of coarse flakes (see fig. 32). The upper surface is in some instances in part or wholly covered by cortex. In the case of especially large nodules, smaller flakes were sometimes obtained before the main blow was struck. In this manner the beautiful, large oval flake (fig. 32, no. 4) was produced. Some oval, coarse flakes probably were detached when the nodules were quartered, a process with which the preparation of the core is begun. Many of the round and oval coarse flakes show indentations or traces of use, and in some cases steep trimming of the edges as well. Consequently, they were used as implements.

Most of the coarse implements found at Markkleeberg are unrolled. Therefore, they were probably struck there and lost directly in the gravel, as the finding of two beautiful, unrolled cores suggests. In addition, at the Leipzig sites, rolled, coarse implements of the same type were also found, which proves that this technique was used everywhere on the banks of the Pleisse at the beginning of Riss glacial times. Finally, we also find coarse implements that are of rather archaic type, strongly rolled, with a very deep patina and referable to Preservation Group 1, which indicates that they are older than the gravel and probably belong to the Mindel-Riss Interglacial. Examples of these have been previously published (Grahmann, 1938*a*); further specimens are shown in figure 21, nos. 1–4. Triangular and pentagonal, coarse implements, and tools from which the rear right-hand corner has been removed, have so far not been found in Preservation Group 1.

d. BLADES AND FLAKE-BLADES

Figures 30; 32–45

(1) *General Observations*

Blades are flakes the length of which is at least double the width. They should also be thin; otherwise they cannot serve as blades, and should have edges which are more or less parallel. If the edges intersect and end in a point, the blade-point develops, and these will be discussed under the heading of points. In the Lower Palaeolithic there already is a tendency to produce long, blade-like flakes. For this purpose, the tortoise, cylinder, and spindle-shaped cores were devised, and the flaking methods were improved. With the crude stone-on-stone technique long flakes were sometimes obtained, but only rarely are they thin enough to be called genuine blades. Breuil (1932*a*) gives two examples from Clacton-on-Sea, but for the other Clactonian sites of the Mindel-Riss Interglacial of Western Europe he gives none. According to Obermaier (1908), however, genuine blades are already represented in the Chellian described by Commont from St. Acheul, which now is included in the Lower Acheulian. They are even more common in the later periods of the Acheulian, and are well developed in the Levalloisian.

At the Leipzig sites, particularly at Markkleeberg, blades and flake-blades constitute the bulk of the archaeological material. Already the group of coarse flakes reveals a tendency toward blade artifacts. In dealing with such pieces one is even doubtful whether they should be classified in this group or with the remaining find material (compare figs. 30; 32, nos. 1–3; and 33). In any case, there are definite transitional forms, and it should be noted that among the blades all techniques of manufacture are represented. Rather frequently, the blades exhibit small, single-surfaced striking-platforms, a striking angle of 100° to 105°, small, graceful cones and a restricted bulb—in other words a technique which extends into the Neolithic. In addition, examples are often found which show the use of the baton technique on single-surfaced or faceted butts.

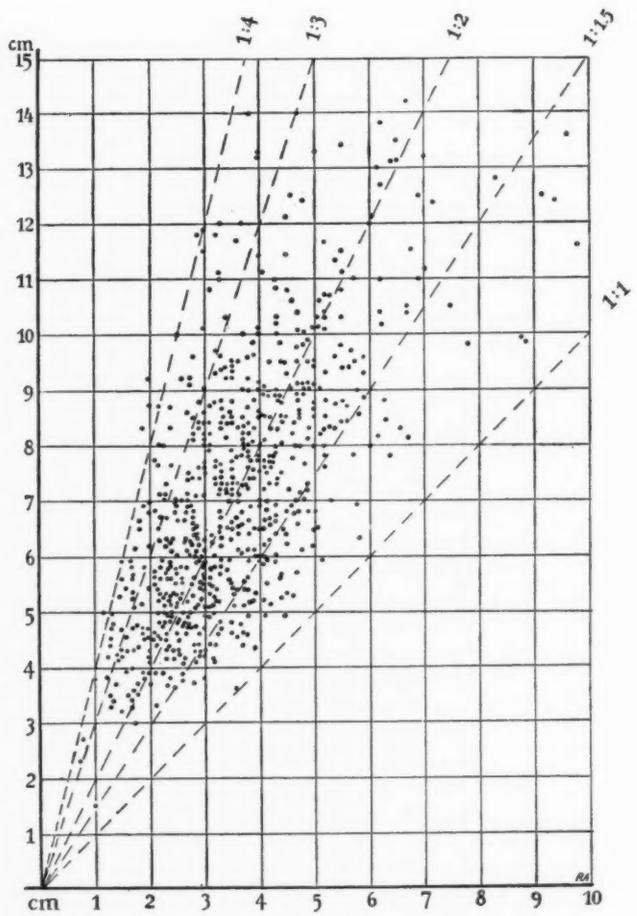


FIG. 18. Length-breadth ratios of the unrolled blades from Markkleeberg.

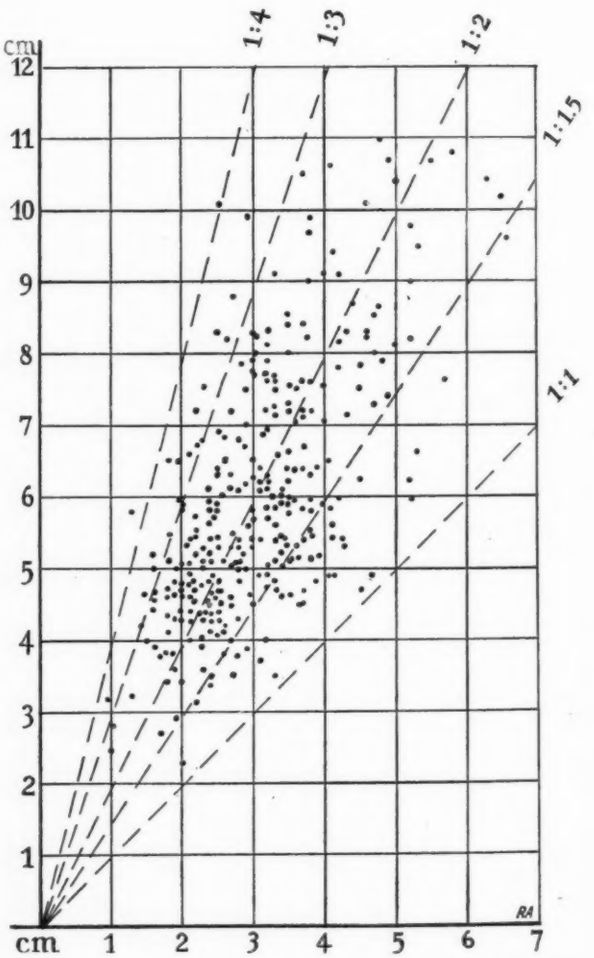


FIG. 19. Length-breadth ratios of the rolled blades from Markkleeberg.

TABLE 10

LENGTHS OF THE BLADES AND FLAKE-BLADES

Preservation Group:	Markkleeberg				Cröbern and Zehmen		All Three Sites	
	2a		*2b*		*2a* and *2b*		*2a* and *2b*	
Lengths	Number	%	Number	%	Number	%	Number	%
14.1 to 15	1	0.2					1	0.1
13.1 to 14	12	1.7					12	1.0
12.1 to 13	13	2.0					14	1.0
11.1 to 12	19	3.0			1	0.7	20	2.0
10.1 to 11	33	5.0	11	3.5	1	0.7	45	4.0
9.1 to 10	60	8.0	10	3.2	6	4.0	76	7.0
8.1 to 9	100	14.0	21	6.7	10	7.0	131	11.0
7.1 to 8	94	13.0	41	13.0	27	18.0	162	14.0
6.1 to 7	112	16.0	44	14.0	*34*	*23.0*	190	16.3
5.1 to 6	*121*	*17.0*	*80*	*26.0*	25	17.0	*226*	*19.5*
4.1 to 5	102	15.0	73	24.0	25	17.0	200	17.0
3.1 to 4	30	4.3	25	8.0	16	11.0	71	6.0
2.1 to 3	3	0.5	5	1.6	2	1.5	10	1.0
1.1 to 2	1	0.2					1	0.1
Total	702		310		147		1,159	

TABLE 11

WIDTHS OF THE BLADES AND FLAKE-BLADES

Preservation Group:	Markkleeberg				Cröbern and Zehmen		All Three Sites	
	2a		*2b*		*2a* and *2b*		*2a* and *2b*	
Widths	Number	%	Number	%	Number	%	Number	%
9.1 to 10	4	0.6					4	0.4
8.1 to 9	3	0.4					3	0.3
7.1 to 8	3	0.4					3	0.3
6.1 to 7	24	3.0	3	1.0	4	2.5	31	3.0
5.1 to 6	50	7.0	10	3.0	11	7.5	71	6.0
4.1 to 5	137	20.0	35	11.0	30	20.0	202	17.0
3.1 to 4	198	28.0	98	32.0	*48*	*33.0*	344	30.0
2.1 to 3	*210*	*30.0*	*121*	*39.0*	35	24.0	*364*	*32.0*
1.1 to 2	69	10.0	41	13.0	19	13.0	129	11.0
0.0 to 1	4	0.6	2	0.6			6	0.5
Total	702		310		147		1,159	

As is to be expected with the employment of various techniques, the blades have rather different shapes. If they are struck as primary flakes from tortoise cores, they have several scars on their upper surfaces, the edges are curved, and the blade is of long, oval form (figs. 39, nos. 4, 6; 40; 41, no. 9). These are the genuine blades of Levallois type (*lame* or *éclat levallois*). On other blades, the upper surfaces have one or more lengthwise ribs, and the edges are straighter. The best blades were struck from cylindrical and spindle-shaped cores; from these cores it is easiest to produce forms with edges that are sometimes nearly parallel or even completely parallel (figs. 35, no. 4; 36–38, and others).

Whereas the blades detached by the hammerstone technique are mostly thick (compare figs. 32, nos. 1–3; 33, and others), beautiful thin blades are made by the other methods of manufacture. The finest, which are only a few millimeters thick, appear to have been produced by using a punch or some type of an intermediary tool. They are mostly small (compare figs. 44, nos. 1–11; 45).

The length and width of the Markkleeberg blades vary within wide limits. The largest are more than 14 cm. long. Judging by the flake scars on a large spindle-shaped core from Markkleeberg, described by Jacob-Friesen (1914: fig. 31), one should expect blades up to 20 cm. in length, as previously mentioned, but so far such blades have not been found. The smaller blades are only a few centimeters long. They are hardly subject to statistical analysis because (*a*) it is difficult to collect them in the coarse sand and gravel, and (*b*) they may well be regarded as simple chips that have been produced during the process of trimming or other types of preparation of cores and implements.

The diagrams (figs. 18 and 19) show the lengths and widths of all the well-struck blades collected in Markkleeberg, and the length-width ratio is also expressed in these illustrations. On tables 10–12 the length-width proportions of the best blades from Markkleeberg, Cröbern, and Zehmen, are set forth quantitatively and from the point of view of percentage values. It will be seen in table 10 that the most frequent length in the Markkleeberg series of both unrolled and rolled blades is 5.1 to 6 cm., but the values differ only very little from those of the two adjacent groups, that are 4.1 to 5 cm. and 6.1 to 7 cm. long, respectively. It should be noted, however, that typical of the site of Markkleeberg is the great quantity of large blades struck on the spot. Here the pieces that are more than 8 cm. long comprise 34 per cent of the total, but only 13.4 per cent of the rolled pieces fall in this category, while at Cröbern and Zehmen the figure is 12.4 per cent. Thus we have in Preservation Group *2a* from Markkleeberg a second peak of high frequency in the 8.1 to 9 cm. group; blades that are more than 9 cm. long amount to 20 per cent of the total, as against 6.7 or 5.4 per cent in the other groups. Blades over 11 cm. long come almost exclusively from Markkleeberg and constitute 7 per cent of all blades from this site. It is these long blades, which have been skillfully struck, that give the Markkleeberg material a distinctive appearance.

Turning to table 11, it will be seen that the most frequent width for the Preservation Group *2a* and *2b* material from Markkleeberg is in the 2.1 to 3 cm. subdivision, and for the same category from Cröbern and Zehmen it is in the 3.1 to 4 cm. range. Thus the average width is approximately 3 cm. Since the greatest number of long blades occur in Preservation Group *2a* from Markkleeberg, it is natural that greater widths

TABLE 12

RATIO OF LENGTH TO WIDTH OF THE BLADES AND FLAKE-BLADES

Preservation Group:	Markkleeberg				Cröbern and Zehmen		All Three Sites	
	2a		*2b*		*2a* and *2b*		*2a* and *2b*	
Length:Width Ratio	Number	%	Number	%	Number	%	Number	%
1:1 to 1:1.5	85	12.0	37	12.0	32	21.0	154	13.0
1:1.5 to 1:2	236	34.0	122	39.0	*61*	*42.0*	419	36.0
1:2 to 1:3	*307*	*44.0*	*131*	*42.0*	50	34.0	*488*	*42.0*
1:3 to 1:4	65	9.0	18	6.0	4	3.0	87	8.0
1:4 to 1:5	9	1.0	2	0.6			11	1.0
Total	702		310		147		1,159	

are also found here. But the over-all situation is hardly changed by this fact.

The most frequent width-length ratio is between 1:2 and 1:3, and the next most frequent figure falls between the 1:1.5 and 1:2 groups (table 12). Blades which are narrower than 1:3 are found almost exclusively at Markkleeberg; among the unrolled pieces from this site they constitute 10 per cent. Together with the few pieces which have a ratio of 1:4 or less, they may be referred to as narrow blades.

The blades in the series under consideration are almost always characterized by indentations of the edges. The indentations, or edge-chipping, are effected partly on the upper side and partly on the lower side; in rare cases they alternate regularly to produce saw-like teeth. In the majority of instances the regular arrangement of the indentations shows that they were purposely made and did not result from heavy use of the blades. Such accidental indentations, or edge-chipping resulting from use, may also be found, but they are irregularly distributed and also rarer.

Some blades show a thinning of the bulbar end, partly as a result of an oblique blow struck from the platform towards the upper side, and partly as a result of the removal of several stepped flakes (compare section 3*b* above). Only in a very few cases has the bulb of percussion been trimmed off. It may be assumed that this type of working was for the purpose of hafting.

(2) *Fully Retouched Blades*

Figures 46 and 47, nos. 2–4, 11, 12

Although most of the blades exhibit continuous indentations, which sometimes may be regarded as simple retouch, purposeful retouch that is continuous is very rarely found (compare section 3*b* of this paper). Sometimes it occurs on only a part of the blade, and in such cases the implement probably should be classified as a side-scraper; more often, however, at least one edge has been retouched along its full length. It seems preferable to consider such pieces as blade side-scrapers, an appropriate term when one considers the fact that generally the dividing line between retouched blades and side-scrapers is poorly defined with respect to both form and presumed method of use. In this study, therefore, we refer to single-edged retouched blades (fig. 46, in part). In contrast to these, we have more frequently double-edged retouched blades. The secondary working is always limited to the upper side, and it has not necessarily been executed along both edges with equal care.

The retouched blades from the Leipzig sites are usually narrow, very seldom are they wide. They were partly made with the bone billet technique, and partly with a hammerstone. Two retouched blades belong to Preservation Group 1 and are, therefore, older than the Riss glacial gravels of the Pleisse Valley (for example, fig. 22, no. 8). All the others are as old as this gravel and were found at Markkleeberg, with one exception. Most of them were manufactured here, since they are unrolled; only a few have been rolled. Some of the retouched blades were worked so skillfully that they could be mistaken for Upper Palaeolithic artifacts (compare fig. 47, nos. 11–12).

Retouched blades are considered characteristic of the Upper Palaeolithic, during which they attain the climax of their development in regard to quality and number, and it is primarily due to their existence here that the Markkleeberg material was considered to be reminiscent of the Aurignacian. However, in rare instances retouched blades already occur in the Lower Palaeolithic; in fact Obermaier (1908) has described a few from different stages of the Chellian (probably = Early Acheulian), and the Acheulian of St. Acheul. Kelley (1937) also gives a few examples of single- or double-edged retouched blades from the Early and the Middle Acheulian of St. Acheul and of Thennes (fig. 1, no. 16; fig. 2, nos. 9 and 10), that is from stages which date from the Mindel-Riss Interglacial.

(3) *Blades with Side Curvature*

Blades with side curvature or hollow notch (lames à coche) occur in all stages of the Aurignacian. But their precursors are already present in the Lower Palaeolithic. Obermaier (1908) has described a primitive blade with a hollow notch from the Chellian (Old Acheulian) of St. Acheul. At the Leipzig sites only a few pieces have been found which can be classified in this group of artifacts. Two of them, both from Markkleeberg, have been reproduced in figures 48, nos. 15 and 16; the blade shown in figure 41, no. 7 could also be classified here, with certain reservations.

(4) *Blades with Transverse Edge*

Some short, broad flake-blades have a long and straight distal cutting edge. Sometimes it has been artificially straightened and exhibits indentations. Since it was used, it must be assumed that these pieces

served a particular purpose. They are not common and thus far are limited to the Markkleeberg locality. Four of them are reproduced on figure 45, nos. 1, 3, 4, and 14. A few other small, broad blades show signs of use of the long edges, as well as of the transverse edge.

(5) *Oblique-Ended Blades*

Figures 47, nos. 1, 5–10, 13; 48, nos. 1–6, 11, 12

On some of the blades in the present series, the distal extremity is lacking. In the majority of cases it has been broken off by force applied from the left front toward the right rear. This type of fracture gives rise to the assumption that in this manner a support for the right index finger has been fashioned in order to be able to hold better the left edge of the blade. In fact, some of the oblique-ended blades have no sharp point which would indicate their use. In other cases, for example with respect to the pieces in figures 47, nos. 5 and 9; 48, nos. 1 and 6, one has the impression that the formation of a point was intended, particularly since these blades were made oblique not only by breaking off the extremity, but also by graver-like blows struck from the pointed end toward the butt. In any case, the production of a point was intended in the case of a few blades on which only the upper edge on the right side was broken off in such a way that a point developed in the axis of the mid-rib, as shown by the examples in figure 48, nos. 4 and 6. These pieces constitute a transition to the awl-like blades.

Three flake-blades from Markkleeberg could also be regarded as transitional to coarse gravers. In addition to the oblique form from the left front toward the right rear, normal for oblique-ended blades, they also exhibit a breaking-off or chipping of the front edge on the left side in such a manner that a sharp vertical edge has been produced. These pieces are reproduced in figure 48, nos. 11 and 12 as double oblique-ended blades; see also figure 49, no. 10.

(6) *Blades with Graver Blow*

Figure 48, nos. 7, 13, 14

Also related to the oblique-ended forms are three blades found at Markkleeberg which show "graver blows" struck from the point towards the butt. With respect to two of them (fig. 48, nos. 13 and 14), it seems doubtful whether these blows were purposely struck or whether the graver facets developed as the result of use; in any case, they indicate neither further working nor use of the point. On the other hand, the piece shown in figure 48, no. 7, gives one the definite impression that here a genuine graver was produced by some heavy blows followed by lighter ones struck from the distal end. It seems to antedate the time when the gravers reached the real peak of their development, which was during the Upper Palaeolithic. However, Obermaier (1908) has described two gravers from what Commont called Chellian at St. Acheul, which now is regarded as Early Acheulian.

(7) *Blades with Awl-like Points*

Figure 48, nos. 8–10

Jacob-Friesen has described a small blade with an awl-like point in his monograph (1914: pl. XXIII, fig. 63), which is again reproduced in figure 48, no. 9 of the present paper. In the same illustration, two similar pieces are shown. Like the blades with graver blow, they are unusual in the series under consideration and represent precursors of a group of implements which is more typical of Late Mousterian and Upper Palaeolithic assemblages.

e. BROAD FLAKES

In this study a series of flakes which because of their breadth cannot be described either as blades or as points are called broad flakes. They are partly of quadrangular and partly of round shape. Some of them are probably accidental forms, but others certainly have been purposely made. The indentation of the edges reveals that these flakes have served as implements.

(1) *Flat Quadrangular Flakes and Transverse Flakes*

Figures 49, nos. 1–9; 50, nos. 1 and 2

Properly speaking, flat quadrangular flakes are blades which became too broad during the process of manufacture. One is even doubtful whether or not one is justified in regarding them as a special group. On the other hand, on account of their breadth, which sometimes is equal to the length, they cannot very well be classified as blades. But the marked similarity between the two groups gives one the impression that most of them were purposely struck. All of them have been produced by the Levalloisian technique, and hence exhibit faceted striking-platforms; almost always the bone billet method has been employed. It may also be noted that all the edges, including the front edge, have been used. In fact the front edge was sometimes further worked not only by indentation, but also by the removal of the irregularities, as shown by examples in figure 49, nos. 2 and 9. Quadrangular flakes have so far only been found at Markkleeberg and here only in small numbers; many of these appear to have received their form unintentionally.

Finally, if the flake is broader than it is long, it is better to speak of transverse flakes. They too show signs of use, particularly of the long distal edge, and also secondary working, as may be observed on the examples in figure 49, nos. 5 and 6. Such transverse flakes are rare; undoubtedly some of them are accidental forms.

(2) *Flat Oval and Round Flakes*

Figures 50, nos. 3, 6–8; 51, nos. 1–9

The tools which are included in this group probably do not represent a real category of implements. They

are similar to the others only in form, which possibly was not intentional in the case of all of them, but sometimes was accidental. All these flakes have multifaceted upper surfaces, and consequently they were struck from tortoise cores by a technique of manufacture which is particularly characteristic of the Levalloisian. In addition, some exhibit faceted striking-platforms, but other pieces lacking this feature belong none the less to the Levallois tradition. Thus they reveal a close relationship to the flat quadrangular artifacts to which we find definite stages of transition (compare fig. 51, no. 7).

f. POINTS

Figure 51, nos. 10 and 11; 52–62

There is in our literature no general and consistent definition of the Lower Palaeolithic "points," and a glance at the French and English archaeological publications shows that there is no uniform opinion as to what should be called a point and how the various types of points of the Lower Palaeolithic should be appraised and measured. There are two alternative definitions: (*a*) a broad one, in which all those tools are designated as points which taper off to a point in the direction of their longitudinal axis, normally at the end opposite the striking-platform; and (*b*) a restricted sense, in which the term "point" is applied only to those pieces which have acquired their pointed shape exclusively or mainly by secondary working. The latter more strictly limited definition is already valid for most points of the Middle and Upper Palaeolithic, that is for industries and cultures in which retouched tools play the dominant role.

With respect to the Lower Palaeolithic material from the Leipzig sites, however, the latter definition is inapplicable, since here the retouched pieces are overwhelmingly in the minority, and this is particularly true of retouched points. If one decides to consider only these pieces as points, a large number of pointed implements would be excluded from the group, notwithstanding the fact that they are very typical. The only alternative would be to find new terms which would not completely correspond to their form. For this reason, the concept of "point" has been used in this study in the broad sense as defined above. But it is necessary to qualify this definition, since a point just as a blade should be longer than it is broad. Triangular pieces with a broad base, such as the crude triangles with Clactonian features, must therefore be eliminated as points; in this respect, compare section 4*c*(2) and figures 27–30 of this monograph. On the other hand, by employing the aforementioned wide definition, those pieces which have received a pointed shape, without purpose and accidentally, are included as points. Jacob-Friesen (1914: 44) in such cases refers to pseudo-points. Of course such forms occur; particularly with respect to blades there are accidental forms that are transitional to points. But actually it is often very difficult to appraise what was in the mind of the man who struck the pieces in question. It is found not infrequently that forms which one could consider as accidental recur again and again and exhibit a remarkable conformity even in details: proof that the same manufacturing technique was repeatedly used for the same purpose. As examples I mention the pieces shown in figures 52, nos. 1–3; 54, nos. 16–19, which are far from being unique representatives of their type. In view of these repetitions, there can be no doubt that these pieces were produced with the intention of obtaining a "point." The same is demonstrated by the subsequent work on the "point" by "graver blows" (fig. 59, no. 10), or by retouch, a process that may be seen on certain pieces. Such observations justify giving the concept of "points" a broader meaning and to understand by the term "point" also thick, pointed flakes (thick points), as well as pointed flake-blades (blade points).

The question of the way the points considered in this paper were used, particularly those which are not retouched, is closely connected with the question of whether their pointed forms are intentional or accidental. In the first place, one can observe on most points that the two edges are indented, either as a result of use or purposefully as the result of the simplest kind of retouching. Their edges can be used for cutting, as blades for example, or for piercing. As far as one can observe the sharpening of the point by retouching, the use of these tools for stabbing is very probable, particularly if the edges are also indented and worked. But often this type of use was only possible when the tool was hafted. That this was actually accomplished, at least in some cases, may be seen from the thinning of the butt end of these implements either by an oblique blow, or by the use of step-flaking directed toward the upper surface; also more seldom by the removal of the bulb of percussion. Jacob-Friesen (1914: 19) has already mentioned step-flaking and its significance for hafting; he speaks of lamellar retouch. This also occurs on blades. These methods of thinning the tool for the purpose of hafting are always necessary in the case of thick points, but with flat points this is less true, except in those cases where the object possesses a strong mid-rib which is opposite the bulb of percussion, making the piece thickest in this region. But, if the blow is struck so that the bulb lies opposite the flake scar between two ridges, subsequent reduction of the thickness of the upper surface is unnecessary. This striking method was used in the case of triangular points as shown in figures 57; 59, nos. 3, 5, 6, 10, and others. Undoubtedly it signifies progress from the point of view of the artisan, and accordingly this tradition was widely accepted in the Middle and Late Levalloisian of the Riss-Würm Interglacial and Würm Glacial times.

One may assume that the hafted points served as spears. Although the small points shown in figure

59, nos. 11–14 can best be interpreted as arrow points, there is no proof that they served this purpose.

In contrast to the hafted points are the thick points. Since they were probably used in the hand, their blunt end was rounded by steep retouching in most cases. Thick points are almost always rather large. Examples are shown in figures 51, nos. 10, 11; 53, nos. 12, 14; 56, no. 8; 57, no. 1; 58, no. 5, as well as the beautifully retouched pieces in figures 23, no. 4; 61, nos. 5, 7, 8, 10; 62, nos. 8, 9, and others.

(1) *Unretouched Points*

Figures 51, nos. 10, 11; 52–60; 61, nos. 1–4

It is difficult to classify the large series of unretouched points. However much the types sometimes deviate from each other, the fact is that all the categories are interrelated by transitional forms in such a way that it is difficult to define the boundary lines between the various groups. The best way to attain this objective is to take into consideration the technique of manufacture as has been done elsewhere in this study. By using this as the main criterion for classification, similar types are included in the same category. Thus the following groups may be distinguished: (i) thick points produced by stone-on-stone technique; (ii) flat points produced by stone-on-stone technique; (iii) flat points produced by bone billet technique; (iv) flat points produced by true Levallois technique; (v) pentagonal points; and (vi) points of various types.

(i) The thick points (figs. 51, nos. 10, 11; 52; 53, nos. 12, 14) are generally crude and coarse. They constitute the transition to the prepared coarse flakes (fig. 29, nos. 5–8) and are always produced by the stone-on-stone technique, possibly on the anvil. As a result the striking angle may be up to 120°. Most of the pieces have a main ridge, rarely several ridges, on the upper surface. Normally the point lies in the middle axis of the piece, but it may be to one side. It is common to all the thick points that the thick basal end has usually been thinned by a blow from the striking-platform obliquely against the middle rib, sometimes by stepped flaking (fig. 52, no. 6), or in both ways (fig. 52, no. 2). No special preparation of the points of these pieces appears to have taken place, unless the chipping exhibited by the specimens in figure 51, nos. 10, 11; 52, no. 7 is to be interpreted in this manner.

(ii) The flat, generally triangular but also leaf-shaped, points which have been struck off with a hammerstone (figs. 53 to 55 in part) as a rule exhibit the characteristics of this technique in its most developed form. But there are also examples on which the bulb has been thinned or even the whole bulbar protuberance has been removed by trimming, as shown by the pieces in figure 54, nos. 18, 19. Moreover, in the case of these points and the others in figure 54, the right rear corner has been struck or broken off, a feature which is not infrequently found in the series of coarse, triangular tools (compare section 4*c* (2) of this paper). The majority of these points have one ridge, and the edges are almost always indented. Sometimes the point of the specimen has been worked by careful retouching, always on the upper surface of the right side, as illustrated by the pieces in figure 53, no. 5 and figure 54, nos. 7 and 12.

(iii) The flat points produced by the bone billet technique (figs. 55, partly, and 56, partly) are similar to those described above in so far as their external appearance is concerned. However, these pieces are frequently longer; some of them may even be described as pointed blades. The striking-platform is mostly single surfaced and sometimes very small. Most pieces have a main ridge which tapers off into the point. Indentation of the edges is almost always apparent, preparation of the point only rarely (for example, fig. 55, no. 4).

(iv) The points produced by true Levallois technique may be subdivided into three groups. The first comprises both short and long pieces which are similar to the pointed blades previously described. They have either one or two longitudinal ridges on the upper surface and are further characterized by their normally rather large, faceted striking-platforms (compare fig. 58, nos. 1, 2, and fig. 59, in part).

Triangular pieces with wide, curved, faceted striking-platforms constitute a second group. The majority of them have two main ridges joined towards the distal end, and between these is a broad, flat flake scar. These points correspond to the pointed *éclats* or *pointes triangulaires* of the French Levalloisian IV to VII, which belong to the Riss-Würm Interglacial and to the Würm Glacial Period (Breuil and Koslowski, 1932: fig. 9, no. 3; fig. 10, no. 4; and fig. 12, no. 2). Therefore, at Markkleeberg they occur sporadically in an earlier horizon; to date only a few such pieces have been found (fig. 56, nos. 5–7, 9).

Finally a series of pointed flakes struck from tortoise cores must be mentioned (compare section 4*b* of this paper). They exhibit several flake scars on the upper surface, and most of them lack a main ridge; furthermore, almost without exception, they have a faceted striking-platform and have been produced by the bone billet technique (figs. 56, no. 8; 57 and 58). With respect to most of these pieces, one cannot be certain whether they were purposely made pointed or whether they are chance forms. It is clearly apparent that the pointed ends of the pieces illustrated in figure 57, no. 5 and figure 58, no. 6 were used. In regard to one piece (fig. 57, no. 3), which properly speaking does not belong to this group, because it was produced by the stone-on-stone technique, it is obvious that the point was made by a transverse blow struck from the left front to the right rear; this fact indicates that the piece is transitional from the oblique-ended blades.

(v) The five-sided pieces or pentagonal points like-

wise constitute an atypical group (figs. 60, nos. 5, 6, 8–12; 61, no. 2). They are characterized by a normally plain, rather narrow striking-platform from which the piece broadens towards the front before tapering off to a point. In this manner a pentagonal, or sometimes even septagonal, form is produced. Normally the blow was struck with a hammerstone. In many cases, the points are rather obtuse and scarcely useful for special purposes, but in other instances (fig. 60, no, 10) they have been specially prepared by fine retouching.

(vi) Only in a few instances is it very difficult to classify points into the above groups. Either the point of impact is on the side, or the pointed end is situated obliquely with respect to the main axis of the piece. Such pieces are illustrated in figures 59, nos. 4, 5, and 60, nos. 1, 3, 10.

(2) *Points with Side Indentation*

Figure 61, nos. 1 and 4

Three of the blade points found at Markkleeberg display an artificial indentation on the left edge, similar to that found on some blades. The purpose of this indentation is not absolutely clear. In the case of the piece shown in figure 61, no. 1, it suggests a preliminary stage in the manufacture of a barbed hook; it could have served as the support for straps or tendons used in hafting, particularly since here a natural indentation would serve such a function (compare fig. 61, no. 4).

(3) *Retouched Points*

Figures 61, in part, and 62

Although most of the points mentioned thus far exhibit indentation of the edges, which frequently is consecutive, points which have been carefully worked in several stages are rare at the Leipzig sites. Very few of them are retouched on one edge, as in the case of the examples shown in figure 61, nos. 6 and 7. Because of their form, they should be considered as points only with reservation, for they might just as well be described as side-scrapers. In particular the piece in figure 61, no. 6, which has a broad, blunt right edge, may be classified as a knife, and indeed it was probably also used for cutting.

With respect to their technique of manufacture and form, those points which are trimmed on both edges belong to various types. Most frequent are points made from blades by careful retouching. Jacob-Friesen has already described two beautiful pieces of this type (1914: figs. 68 and 69); they are again reproduced in figures 61, no. 8 and 62, no. 8, together with their side and base views. In addition, there are in figure 61, nos. 5, 7, and 10 three other pieces of the same type. All five points were collected during the early era of the Markkleeberg discoveries in pits *b* and *c*, and in the northern end of pit *d*. Since later on finds of this type did not recur, one is perhaps justified in concluding that these objects were all derived from the same factory site, with the possible exception of the one shown in figure 61, no. 9, which has a faceted striking-platform and was manufactured by the bone billet technique, in contrast to four others which exhibit in typical fashion all the distinctive features of a heavy hammerstone technique. These four points were made from broad, heavy blades with one or two ribs. As for the Levalloisian piece (fig. 61, no. 9) a *pointe triangulaire* could have been used from which the rear left corner was broken away. This point recalls a Levalloisian specimen dating from the beginning of the Würm Stage found at St. Acheul and described by Breuil and Koslowski (1932: 33, fig. 6, no. 3), but apparently it is not quite so well retouched. Similar to these points made from flake-blades, is the piece shown in figure 61, no. 3; however, this is not quite as perfectly retouched as are the former ones, since it is only worked on the left side and along the right edge near the point.

Related to the points described above is the beautiful thick point (fig. 23, no. 4), which belongs to Preservation Group 1 and therefore probably dates from the Mindel-Riss Interglacial. It is made on a very broad flake and is outstanding because of its careful surface and edge retouch from all sides, which partly extend onto the lower surface where the bulbar protuberance has been removed. It is the same method of manufacture which was used in the production of good bifaces, and this thick point is closely related to this group. In the series from the Leipzig localities it is out of place, since actually it is an Acheulian type. Kelley (1937: fig. 1) has described similar points from the Early Acheulian of St. Acheul, which is placed in the first half of the Mindel-Riss Interglacial Period. Furthermore, in the Acheulian V series found in the Old Loess (Riss Glaciation) of the same region (Kelley, 1937: fig. 5), as well as from the Early and Middle Acheulian of Southern England (Kelley, 1937: fig. 8), the same type also occurs. Apparently, during the Mindel-Riss Interglacial, Acheulian influences penetrated as far as the middle part of Central Germany.

Leaf-shaped points of the type reproduced in figure 62, nos. 1 and 6, are likewise represented in the Acheulian of France. The blunt point (fig. 62, no. 3) could also be included here, but such pieces are very rare in the present material.

The partially tanged points shown in figure 62, nos. 2 and 10, are very exceptional. They suggest very crude prototypes of Font Robert Points and are extraordinary rarities for such an early horizon as the beginning of Riss Glacial times.

Furthermore, a group of small retouched points should be mentioned which are very similar to each other, but deviate from those previously discussed. The group in question consists of a total of eight pieces, three of which are reproduced in figure 62, nos. 4, 5, and 7. All of them are short—only 21–42 mm. long—and have

been made from flakes. With the exception of one piece, however, the striking marks have either partially or completely disappeared as a result of subsequent work. This work has extended over nearly the entire surface, as shown by the flat flake facets. The butt end has been thinned, and in addition the edges were extensively retouched, particularly on the left side. Although these points were all found at Markkleeberg, they are somewhat rolled and probably were manufactured farther up the river. Braune (1928: 81) has described a similar but somewhat larger point as a "wedge."

Finally as a special type one more thick point (fig. 62, no. 9) should be mentioned. It was made by carefully working a thick flake of Clactonian type, the entire upper surface and edges of which have been retouched. Similar pieces are found in the 100-foot terrace deposits of the Thames near London, which are assigned to the Mindel-Riss Interglacial. Breuil (1932*a*: fig. 12, nos. 10 and 11) has described similar examples, but the upper surface of the latter exhibits areas of the original crust. Therefore they appear to be somewhat more primitive than our point. The latter closely recalls the thick, half-wedge-like points from Warren Hill and High Lodge, east of Cambridge. Breuil (1932*a*: fig. 18) reproduces typical examples; he considers that these horizons are older than the Riss, but the dating of these deposits, as well as the conditions prevailing when they were accumulated, is still uncertain.

g. SIDE-SCRAPERS

Figures 63 to 66

I do not follow the normal practice of classifying as side-scrapers those simple flakes which otherwise cannot be assigned to one of the clearly recognizable groups. For such a procedure is arbitrary and subject to misunderstanding. In the following discussion only those tools which show secondary working mainly on *one* edge, either by retouch or in some cases by continuous indentations, will be considered as side-scrapers. The opposite edge is generally naturally blunt, or else it exhibits a protective trimming. Originally, the term side-scraper was used only in this sense.

Flakes retouched as side-scrapers are found throughout the early horizons of the Lower Palaeolithic of Western Europe, but very little attention has been paid to them. Obermaier (1908) gives examples from the so-called "pre-Chellian" of St. Acheul which Breuil (1932*b*) later called the Abbevillian. There are also flakes that have been retouched as side-scrapers in the Clactonian of Clacton-on-Sea (Breuil, 1932*a*). Furthermore, true side-scrapers with consecutive retouching of the edge, which typologically correspond with examples associated with younger assemblages, were described by Obermaier (1908) from the Chellian of the Somme Valley, which actually belongs to the beginning of the Mindel-Riss Interglacial and should be considered as Early Acheulian, according to Breuil. Kelley (1937) also illustrates true side-scrapers from the Early Acheulian which were made from flakes. Their proportion apparently increases in the later stages of the Acheulian, and the type reaches the peak of its development in the Mousterian.

The term side-scraper answers in advance the question as to their use, but whether or not this is always correct is doubtful. In any event, from a functional point of view, a number of these artifacts would have served better as cutting than as scraping tools, and they may have been used in much the same manner as the woman's knife (ŭlăq) of the Greenland Eskimos. In particular this holds true for many side-scrapers that have been made on blades; in a sense they constitute forms that are transitional to blades which are retouched along one edge (compare figs. 63, nos. 3, 6, 8, and 10; 64, nos. 4, 5, and 8).

The side-scrapers from the Leipzig sites are partly made from flakes, but on some of them no trace of either the striking-platform or the bulb can be detected. In some cases these features may have been removed before the secondary working. However, if on the lower surface no traces of conchoidal ripple marks can be observed, it is probable that we are dealing with the use of natural fragments which were worked into side-scrapers by secondary working of the edge. Examples are given in figures 63, nos. 1, 2, 4, and 65, no. 3. Since the majority of these tools consist of pieces made from flakes, this is a very peculiar phenomenon; but it likewise occurs in the case of the ordinary scrapers and awls.

The flakes or flake fragments were usually retouched on the upper surface, very seldom on the lower surface in the manner of the examples in figure 63, nos. 3, 5, 7, 8, 10. There are also instances of inverse working where one edge has been trimmed from above and the other from below (see fig. 65, no. 3). Seldom has the same edge been sharpened from both sides as on the piece shown in figure 63, no. 9. The worked edge is normally flat with an angle of about 30°, but sometimes it may be quite steep.

On many pieces only a part of the edge is retouched, as for example on the side-scrapers shown in figure 63, nos, 3, 8, and 10, and on the large broad flake in figure 64, no. 3. However, others show more or less careful working along the entire edge. The latter is rarely straight, as in the case of the blade side-scraper (fig. 64, no. 11), the rolled side-scraper (fig. 65, no. 2), and especially the two crescent-shaped side-scrapers (fig. 63, nos. 5 and 7). More frequently the tools in this category have a more or less convex edge as seen by the examples given in figures 64, nos. 4, 5, 7, 8, 9, 10, 12; 65, no. 1. The oval side-scrapers (figs. 64, no. 1 and 65, no. 5), which are very superficially worked almost all around the edges, constitute a comparatively rare, special form. The otherwise carefully worked side-

scrapers with the bulbar portion trimmed away are of very infrequent occurrence; two examples are reproduced in figures 65, no. 3 and 66, no. 1.

A special category must be reserved for certain side-scrapers which exhibit on the lower surface of the side opposite the working edge one or more flake scars due to the careful removal of flakes, as seen by the examples in figures 65, nos. 4 and 6; 66, nos. 2 and 3. This forms a concavity which probably served as a support for the finger or thumb, or even for hafting, according to how one considers these objects were used. On all pieces in this category the concavity is situated in the same relative position. In the event that this feature served as a support for the thumb, they were all used in the same manner and with the same hand, probably the right hand. Only four such side-scrapers have been found so far, and all of them come from Markkleeberg, pit *d*. They belong to the Schulte Collection which was made in the 1930's. This suggests that these very specialized side-scrapers were found rather close to each other during the exploitation of the gravel during those years, and that they may have either been derived from the same site or lost directly on the river bank by the same group of primitive hunters. A side-scraper from Langenstein described by Hemprich (1932) as a hand-axe (biface) exhibits similar working as in the case of the present side-scrapers, and it also has a concavity on the lower side. Unfortunately, the age of this piece is not known, and it is quite uncertain to which archaeological horizon it belongs.

The side-scrapers with a concavity or groove undoubtedly constitute a very progressive group, possibly the most highly developed implements from the Leipzig sites. In general, prepared coarse flakes with one of the rear corners removed, and blades with blunted backs first show a tendency to adjust the flake or the retouched tool to fit the hand by further working. This tendency is further perfected in the case of the side-scrapers with a concavity or groove. Thus, they show the beginning of a technical progress which reached a high state of perfection in the Mousterian and in the Upper Palaeolithic.

On the basis of the typological range of the side-scrapers from the Leipzig sites, this series of artifacts of Riss age suggests forms of the classic Mousterian; none the less, only in isolated instances do they approach the delicacy of the latter. Furthermore, the total number of side-scrapers in our material is far below that found in a normal Mousterian assemblage.

Purposely retouched side-scrapers belonging to Preservation Group 1 are very rare. In this group only two pieces were found which can be regarded as true side-scrapers (fig. 23, nos. 2 and 6). However, it should be taken into account that, as a result of the strong rolling of these older pieces, the retouching easily disappears so that originally the proportion of side-scrapers may have been greater than is now apparent.

h. END-SCRAPERS

Figures 67 to 70, nos. 1–3

It is customary to distinguish end-scrapers from side-scrapers, but the diagnostic features on the basis of which this distinction is made are sometimes as closely related as is the process of side-scraping to that of end-scraping. Moreover, we have no direct evidence concerning the use of such tools during the Lower Palaeolithic. According to Rutot and Schweinfurth, whose opinion Obermaier (1908) follows, side-scraping is executed with a side edge which is usually curved in an archwise fashion; on the other hand, end-scraping is done with a transverse edge similar to planing. This definition is almost always used, and I shall also adhere to it.

During the Upper Palaeolithic, implements developed to such a degree that a wide range of end-scraper types occupy a conspicuous and special position in comparison with the convex- and straight-edged side-scrapers. With respect to many Lower Palaeolithic tools, however, it is sometimes doubtful whether or not they should be considered as side-scrapers or as end-scrapers, since their forms are not yet as developed as in the case of their descendants. Although they are normally larger and cruder than the later forms, they none the less reveal a fairly clear relationship with the latter.

The end-scraper category includes implements of rather different form. A steeply retouched working edge is common to the end-scraper, whereas in the case of the side-scraper the working edge is usually flat. Another difference is that the working edge of the end-scraper rarely occurs on the side of the implement parallel to its long axis, but usually extends across the end in a longitudinal manner so that one speaks of an end- or front-scraper (*Stirnkratzer*). Since the lower surface of the latter is almost always slightly curved, the working edge is usually rather sharp in spite of the steep retouch; thus one may speak of curved end-scrapers. However, it is incorrect to call concave-ended implements with steeply trimmed indentations hollow scrapers: they should be referred to as indented scrapers. Incidentally they always have a flat, uncurved, lower surface, which is also true of the steep scrapers.

End-scrapers already occur in several Lower Palaeolithic horizons, together with hand-axes and early assemblages of flake tools. Obermaier (1908) describes very primitive end-scrapers from the Early Chellian (= Abbevillian, according to Breuil, 1932*b*) of St. Acheul, and various types of scrapers from the Chellian (Breuil's Early Acheulian). Kelley (1937) has recorded end-scrapers in Acheulian II and III of St. Acheul, which belong to the early Mindel-Riss Interglacial. Of the same age are the end-scrapers from the oldest series of the Clactonian from Clacton-on-Sea, which are reproduced by Breuil (1932*a:* fig. 2, nos. 19

and 20). Hemprich (1932, supplement) illustrates a large end-scraper from the Riss gravels of the Holtemme at Grossquenstedt, and such pieces are also known from the site of Hundisburg, which is of the same age. But to date steep- and keeled-scrapers apparently have never been described from the Lower Palaeolithic.

Tools which could be classified as scrapers, because of their steep trimming of the working edge, are not especially rare. Probably they were even more abundant than would appear on the basis of our table, since presumably the early collectors, whose main attention was focused on the blades, hardly noticed them. Our scrapers have been made partly on flakes, sometimes on true blades, and, even more frequently than in the case of the side-scrapers, on natural fragments. Most of the latter have such an irregular form that they easily escape the collector's attention.

End-scrapers with a working edge which runs across the front (distal) end of the piece are the most frequent type from the Leipzig sites. They first appear in Mindel-Riss Interglacial times, as proved by the very fine piece shown in figure 13, no. 6. End-scrapers of the same age as the Riss gravels have mostly been made on broad flakes or blades, hence one may refer to them as end-of-blade scrapers (figs. 67, no. 2; 68, no. 11). The hollow or S-curvature of the lower surface, which is not uncommonly found on such flakes, has actually made the steeply retouched working edge into a curved scraper in many instances (figs. 67, no. 3, 4; 68, nos. 3, 4, and others). Some end-scrapers are extraordinarily large, as for example a specimen in the Schulte Collection, not reproduced here, which is 21 cm. long, 22 cm. broad, up to 8.5 cm. thick, and weighs 3,180 grams. The steep retouching of its distal end has been very carefully executed, and the front portion of the left edge has also been worked in the same manner. With respect to type and form it is very similar to the large flake (fig. 23, no. 5), the distal edge of which likewise exhibits scraper retouch. A second very large piece with a long steeply retouched scraper edge formerly existed in the Prehistoric Seminar of the University of Leipzig, but it was lost as the result of the air attack on December 4, 1943. Other large scrapers are shown in figure 67, but in general these implements are rather small. Some of them, particularly the double-ended scrapers in figure 69, nos. 2, 3, 5, recall Upper Palaeolithic forms. But in France such pieces have been recorded from the Early Levalloisian, for example from Cassan near Isle Adam.

The steeply retouched working edge is normally found on the front end, seldom on the side. In most instances this is conditioned by the form of the natural piece (figs. 68, no. 8; 70, no. 2) or by the convenient curvature of the extremity (fig. 68, no. 10). The same holds true in the case of the indented scrapers which occur in various forms, most of which are irregular and often display an awl-like projection or point (compare figs. 69, nos. 1 and 7; 70, no. 1; 71, nos. 4 and 11).

If the end-scrapers and indented types are very thick, one may describe them as high scrapers. The latter are not common, and they were always made on natural fragments, which, if they had the correct shape and an even and smooth lower surface, it was only necessary to retouch the edge steeply (fig. 68, no. 6) and fashion the indentations (fig. 69, no. 3). The keeled scrapers (fig. 69) were likewise made on natural fragments of flint which were suitable because of their form. They always have a smooth, even, uncurved lower surface, away from which the edges, sometimes indented, were more or less steeply retouched. Although these early types of keeled scrapers are much coarser and cruder than the well-known Upper Palaeolithic examples, there can be no doubt that they should be regarded as the prototypes of the latter.

i. AWLS AND RELATED IMPLEMENTS

Figures 70, nos. 4–6; and 71

Implements of various types which have a point formed by edge retouch are designated as awls or borers. Only in rare instances do implements worked on both surfaces exhibit an awl-like point (compare Obermaier, 1908: fig. 79). Most of the awls are made on flakes or natural fragments, and the original form of the latter influenced the location of the point. If the point lies at the distal end of a flake, a straight awl results, otherwise one refers either to oblique awls or lateral awls, if the point is placed longitudinally.

In the Upper Palaeolithic many different types of awls may be distinguished, which are described as nosed, peaked, spiked, or other forms. In the Lower Palaeolithic, however, the types of tools are not as yet established and are mainly influenced by the original form of the flake or fragment that was utilized. This may also be observed on the examples which Obermaier (1908) illustrates from the Early Chellian and Chellian of St. Acheul, stages which Breuil (with Koslowski, 1931) attributes to the Abbevillian and Early Acheulian and places in the Günz-Mindel, as well as in the beginning of the Mindel-Riss Interglacial Periods. Apparently the types are less evolved in the pure flake cultures. Among the Clactonian flakes from Clacton-on-Sea, which Breuil (1932*a*) describes, only a few occur which exhibit the incipient development of peaked projections (e.g., Breuil, 1932*a*: 142, nos. 27 and 29; 144, no. 41). Several pieces (Breuil, 1932*a*: 147, nos. 55, 59 and 60) show signs of nose-shaped protuberances; only one example from the Clactonian of Caversham Heights, near Reading (Breuil, 1932*a*: 158, fig. 13, no. 4), may be considered a straight awl.

Most of the awls from the Leipzig sites have been made from natural fragments of flint, whose form was considered suitable for that particular purpose. Then a limited amount of retouching along the edges was

often sufficient to produce an awl-like point. Sometimes flakes have been worked in the same manner. In some examples the awl-like point is in the center of the piece, in which case graver-like blows were used, and in other instances it is situated in front and to the side so that spiky forms have resulted. On one specimen (fig. 71, no. 4) two symmetrically arranged little horns were neatly worked out on a single scraper edge. On account of its smooth lower surface and the steep retouching, this piece may also be classified as a high scraper. The implements shown in figure 70, nos. 5 and 6; and 71, no. 11, also may be considered combination scrapers and awls, which in each case has resulted from the fact that the natural form of the flint was exploited.

j. BIFACES OR HAND-AXES (COUP-DE-POINGS)

Figures 72 to 75

The bifaces or hand-axes are unquestionably the most conspicuous tools of the Lower Palaeolithic. Therefore, they were more frequently the main subject of the collector's attention, whereas the often more numerous associated artifacts were at first neglected.

The typological classification of the Lower Palaeolithic of France was based originally only on the hand-axes. They were primitive, big, and crude in the Chellian; more carefully worked, but still usually big, in the Acheulian; less numerous, smaller and of "degenerate" shape, in the Mousterian. Later Obermaier (1908) distinguished the Early and Late Acheulian stages on the basis of the typology of the hand-axes. Breuil suggested that the not always appropriate term hand-axe or *coup-de-poing* be replaced by "biface" (*Doppelseiter*) for the bilateral pieces. In his classificatory system he also took into account the technique of manufacture. Only the pieces struck on the anvil were attributed to the Abbevillian. The Acheulian was subdivided into seven stages which partly belonged to the Second and partly to the Third Interglacial Periods. Furthermore, with regard to certain stages of the Levalloisian, as well as the Mousterian, the occurrence of bifacial forms served as the main basis for the distinction.

Since in almost all stages of the Lower Palaeolithic of France bifaces of various types occur, a stratigraphic classification based on a single find is possible only in rare cases. In general such a determination requires a whole series of bifaces. It should also be noted that here as well as everywhere else older forms persist alongside the more progressive types. Therefore, in addition to the well-worked bifaces of the Acheulian, one also finds some examples which still exhibit the features of Abbevillian technique.

It has been shown that in Europe the distribution of bifaces is preponderantly western. In the main they seem to be associated with culture groups whose bearers apparently preferred warmer climates, and perhaps on account of the colder winters, did not penetrate very far to the east. Naturally, in the areas bordering on the eastern and northern flake and blade tool complexes, the various cultures influenced each other. Whether in these border regions the developmental stages of the bifaces, which may be recognized in France, still have a typologic and stratigraphic significance, cannot be ascertained on the basis of the present evidence.

At the Leipzig sites only one biface (fig. 11, no. 4) has so far been found which, on the basis of its state of preservation, can be attributed to the warmer period preceding the Riss Glaciation. To date the material which is of the same age as the Riss gravels includes a total of 14 bifaces—12 from Markkleeberg and 2 from Zehmen. The majority of these are unrolled.

As may be seen from the illustrations in figures 72 to 75, the bifaces in the present series are of medium size and exhibit various forms, partly as a result of the original shape of the core or nodular piece which was used. Nevertheless, ovals, almond-shapes, and pointed ovals, i.e., types which in France are characteristic of the Middle Acheulian, prevail. In any event, with respect to the present series, the working is simpler than it is in the case of Western European examples of the corresponding stage. The piece showing the best workmanship is the almond-shaped biface (fig. 74, no. 3), one of the first to be described from Markkleeberg (Jacob-Friesen, 1914: fig. 13). The piece (fig. 72, no. 4) is rather well made; and the same holds true for the large biface of flat-iron shape (fig. 75, no. 2), which was found at Zehmen and may be considered a true hand-axe (compare Grahmann, 1938*b*). A special feature of the pieces shown in figure 73, no. 1 and figure 72, no. 6 is the use of the stone-on-stone technique, which otherwise is characteristic of the Abbevillian and the Early Acheulian. To the fact that suitable nodules were used must be attributed the presence of the original cortex on 9 of the 14 bifaces from Markkleeberg and Zehmen. For the same reason, the dark grey-black flint described on page 532 was especially preferred, since it occurs in relatively small nodules that have smooth surfaces. Six pieces were made of this flint, which is a much higher proportion than is true of the other tools.

The form and technique of manufacture of the majority of the bifaces in the present series indicate that they are strangers in the normal assemblage of tools. With respect to the better-made pieces, one may perhaps assume that representatives of a true biface culture penetrated eastward as far as Markkleeberg, but the less well-made specimens were probably manufactured by men who were accustomed to striking flakes and blades. Therefore, the influence of biface culture was very slight, for the flakes and blades could be produced more easily and quickly and they were always superior to the bifacial tools, especially for cutting. It is difficult to understand why one-half a biface was

made from a flake-blade as in the case of the fragment shown in figure 72, no. 7. Furthermore, it is peculiar that portions of 4 out of 14 bifaces have been broken off. This points to violent use, possibly as prying or levering implements.

5. QUANTITATIVE ANALYSIS OF THE IMPLEMENT TYPES FROM THE LEIPZIG LOCALITIES

A description of the archaeological material from a given site should include not only a consideration of the types and the working methods by which the tools found there were manufactured, but also a quantitative analysis of the series as a whole. In most cases this approach is followed in the evaluation of Mesolithic and Upper Palaeolithic assemblages, but as yet it has not been employed in Germany with respect to the Lower Palaeolithic. In part this may be due to the infrequent occurrence of such finds. But the abundance of the material from the Leipzig district makes it advisable to use the quantitative approach, and the results are shown on tables 13 to 15 (pp. 563–65) with respect to each site for the three preservation groups.

Table 13 gives a comprehensive break-down of all the material brought to light thus far—in sections I–III for each of the sites at Markkleeberg, Cröbern, and Zehmen; in section IV for the few additional finds in the Leipzig district; and in section V for all the localities together—a total of 3,150 pieces. Of these 2,686 are from Markkleeberg, 99 from Cröbern, 319 from Zehmen, and 46 from all the other localities near Leipzig. On this basis the significance of the Markkleeberg sites is at once apparent.

The importance of Markkleeberg during prehistoric times is further shown by the high proportion of fresh pieces from pits *Ma-Me*, i.e., pieces that were used and lost on the spot, as well as a certain number that were probably made there. In all 1,796 specimens have been placed in this category—more than two-thirds of the total material from here. Next to Markkleeberg, Zehmen has furnished the greatest relative number of the unrolled pieces, but this proportion is under 30 per cent of the total material from Zehmen. The few fresh finds from Cröbern and the miscellaneous localities are of little significance.

Whereas the unrolled objects are from the site where they were collected, this is not necessarily true in the case of the rolled pieces. The site where these were produced, i.e., the place where they were used or at least set down and lost, may only be inferred in that it must have been somewhere near one of the banks of the Pleisse River during Riss glacial times, and that the objects were then swept away by the river and incorporated into the gravel. Consequently, the locality where such pieces were found is only of significance with regard to the origin and appraisal of the series as a whole, because of the fact of their stratigraphic position. Therefore, it is not only justified but quite correct to consider all of the rolled pieces of Preservation Groups 1 and 2 from the sites in the Leipzig region as representative of the contents of the Riss glacial deposits of the Pleisse, and in some cases of the Elster as well. For this reason the totals of these pieces from all the sites together have been computed in section V. Finally in the two large columns of this section the totals for Preservation Groups *2a* and *2b* together are given, in order to show the average values, including the fresh pieces, of the material from the deposits in question. It may be seen that the 108 pieces referable to Preservation Group 1 constitute only about 3 per cent of the total material, whereas the 1,126 rolled pieces belonging to Preservation Group *2b* constitute more than 35 per cent.

The high proportion of unrolled pieces from Markkleeberg suggests that workshops were located nearby. This seems to be confirmed by the fact that 61 unrolled cores were also found here, representing 3.5 per cent of the entire unrolled series from Markkleeberg. The large area covered by pit *Md* at Markkleeberg and its exploitation by collectors over a period of many decades have demonstrated the presence here of rolled cores, but their proportion amounts only to 1.4 per cent of all pieces from Markkleeberg in the *2b* group, which is less than half the proportion established for the unrolled pieces. On the basis of the proportion of cores established for Markkleeberg, one would expect to find three unrolled and two or three rolled cores in the Zehmen material. Yet no cores have ever been collected there, although two small examples come from Leipzig-Lindenau.

Finally, the unprepared coarse flakes also indicate the former existence of workshops in the Markkleeberg region, for in part they are certainly partially finished tools, or possibly waste material from the preparation of nodules and cores. Furthermore, such coarse flakes occur more abundantly in the series of unrolled material than in the rolled group. At Markkleeberg they amount to 5.9 per cent and at Zehmen to 4.4 per cent of the unrolled finds; in the total material referable to Group *2b*, however, they only amount to 2.5 per cent.

With regard to the finished artifacts, by far the highest proportion from all localities and in all Preservation Groups have been made from flakes. With the exception of the unprepared coarse flakes mentioned above, their proportion amounts to more than three-fourths of all the material from all sites and in all Preservation Groups. In comparison with them the hand-axes are very insignificant; they constitute only 0.5 per cent of the total material. Of a total of 15 hand-axes, 13 were found at Markkleeberg and 2 at Zehmen. It is an interesting fact that almost all of them are unrolled; this indicates that they were preponderantly used and lost at Markkleeberg.

In the balance of the series, blades and flakes prevail by far. It is of interest to note that their proportion

with respect to the total find material is practically the same at all localities and in all Preservation Groups. With regard to the proportion of unrolled pieces from Markkleeberg, Cröbern, and Zehmen, the figure only varies between 45 and 50 per cent; for the rolled pieces from all the sites together it amounts to 47.8 per cent; and for the material in Preservation Group 1 it works out at 48.2 per cent of all finds. Next to the blades, points constitute the most numerous category. At Markkleeberg their proportion amounts to 11.3 per cent and at Zehmen to 12.1 per cent of the unrolled pieces—a striking conformity. The value of 13 per cent for all the points in Preservation Group 1 also corresponds very well. On the other hand, it is a peculiar fact that in Group *2b*, points constitute only 7.4 per cent. At Markkleeberg the implement category including side-scrapers, end-scrapers, and awls or perforators is, with 11.2 per cent, as well represented as the points, but at Zehmen, where the figure is only 4.4 per cent, this does not hold, and the same is true with respect to the Preservation Group 1 material with only 5.5 per cent. On the other hand, the value of 13 per cent for Group *2b* appears normal.

In computing the foregoing percentages, the total material has been considered in each instance, i.e., including the cores and the unprepared coarse flakes, neither of which belong to the category of finished artifacts. However, the inventory of the various types of tools from the Leipzig sites may more correctly be appraised if these finds are eliminated before the percentages are worked out. In any case, it is desirable to omit the small unprepared flakes, which should be regarded as objects that proved to be failures either because the parent block was of poor quality, or because the artificer was unskillful. If one deducts these finds, only the genuine implements remain, and in table 14 the inventory of the tools for all the localities has been given in the same manner as in the case of table 13, together with the percentages. This table will permit one to make comparisons with other localities where crude flakes, cores, and defective pieces have not been considered.

In an appraisal of the unrolled tools only the Markkleeberg (with 1,491 pieces) and Zehmen (with 73 pieces) sites can be considered, since Cröbern and the other localities have produced so few implements that the percentage values are not significant. But in the case of Markkleeberg and Zehmen the proportions for almost all implement groups show a striking conformity. The values for the prepared coarse flakes vary between 8 and 8.2 per cent, that of the blades and flake-blades between 56.2 and 58.8 per cent, that of the points between 13.6 and 15.1 per cent, that of the scrapers between 5.5 and 6.5 per cent, and that of the hand-axes between 0.8 and 1.4 per cent. Differences were found with regard to the broad flakes, of which there are 5.1 per cent at Markkleeberg and 13.7 per cent in Zehmen; furthermore, the figure for side-scrapers and awls amounts to 7.1 per cent at Markkleeberg, but these tools are missing completely at Zehmen.

Since the figures for the majority of the types of implements from the two main sites show roughly the same proportions, the percentage values given in the fourth column of section V for the 1,585 unrolled implements collected at all localities deviate very little from those computed for the site of Markkleeberg alone.

We may also note the surprising fact that the percentages for all tools referable to Preservation Group *2b* (912 pieces were considered) in certain categories completely correspond to the values for Group *2a*. A comparison of the fourth and sixth columns of section V shows this very clearly in the case of the prepared coarse flakes and the blades, and approximately for the broad flakes, the side-scrapers and the awls. In Preservation Group *2b*, on the other hand, the proportion of points and hand-axes seems too low, while that of the scrapers is strikingly too high. The difference in the values for points and hand-axes at Markkleeberg is undoubtedly a result of the fact that, as a workshop and camp site, this locality furnished greater numbers of these tools than the average. This also explains why almost all the more highly developed implement types are found only at Markkleeberg. The small proportion of scrapers from this locality is possibly due to the method of collecting, which here was in part done by sand pit workers; the common types of small scrapers caught their attention less than did the normal blades. On the other hand at the other pits, collecting was done only by experts and amateurs, who paid attention to every piece.

In accordance with the above discussion, the percentage values given in the last column of section V for all pieces of Preservation Groups *2a* and *2b*—i.e., the total material from the Riss glacial gravels—naturally do not deviate significantly from those for the fresh, unrolled pieces from Markkleeberg. On the average the proportion of points is a little smaller, that of the scrapers a little higher than at Markkleeberg.

Finally, with respect to the heavily rolled, white patinated implements of Preservation Group 1, the percentages given in the second column of section V also show on the whole only a slight divergence from the figures mentioned above, especially if one takes into account the fact that only 91 pieces are involved. In marked agreement are the values for the blades and for the side-scrapers. The proportion of the broad flakes is too low, which is probably accidental; also low is the percentage of the scrapers, which certainly results from the fact that the steep scraper trimming is easily obscured by rolling, which makes it impossible to recognize any longer these usually rather irregularly formed pieces as tools. Somewhat too high is the proportion of points and especially of crude tools. The latter fact

TABLE 13

QUANTITATIVE ANALYSIS OF THE ARTIFACTUAL MATERIALS FROM THE LEIPZIG LOCALITIES

Locality:	I Markkleeberg				II Cröbern				III Zehmen				IV Miscellaneous Sites			V Total: All Sites						
	a	b	c	d	a	b	c	d	a	b	c	d	a	b	c	a	b	c	d	e	f	g
Preservation Group:	1	2a		2b	1	2a		2b	1	2a		2b	1	2a	2b	1		2a	2b		2a and 2b	
	No.	No.	%	No.	No.	No.	%	No.	No.	No.	%	No.	No.	No.	No.	No.	%	No.	No.	%	No.	%
Nuclei (Cores)		36	2.0	10														36	10	0.9	46	1.5
Disc-shaped and Tortoise Cores		10	0.6	1											1			10	2	0.2	12	0.4
Cylindrical and Prismatic Cores		10	0.6	1											1			10	2	0.2	12	0.4
Spindle-shaped Cores		5																5			5	0.2
Total of All Cores		61	3.5	12											2			61	14	1.2	75	2.5
Unprepared Coarse Flakes		107	5.9	27		2	17			4	4.4			3	1	4	3.6	116	28	2.5	144	4.7
Prepared Coarse Flake Implements	7	121	6.7	54	2	1	8	9	4	6	6.6	16	1	1	1	10	9.8	129	80	7.1	209	6.9
Total of all Coarse Flakes	7	228	12.6	81	2	3	25	9	4	10	11.0	16	1	4	2	14	13.0	245	108	9.6	353	11.6
Small, Unprepared Trimming Flakes	12	137	7.6	96	1	1	8	28	3	14	15.4	40	1	1	8	17	15.7	153	172	15.3	325	10.7
Blades of All Types	23	876	48.8	403	5	6	50	22	24	41	45.0	90		7	3	52	48.2	930	538	47.8	1,468	48.2
Broad Flakes	2	76	4.3	60				6	2	10	11.0	11			6	4	3.6	86	63	5.5	149	4.9
Points of All Types	7	203	11.3	56	2	2	17	6	5	11	12.1	19		2	2	14	13.0	218	83	7.4	301	9.9
Side-Scrapers	3	76	4.2	43	1			1	1			7			1	5	4.6	76	52	4.6	128	4.2
End-Scrapers		98	5.4	73				4	1	4	4.4	4		3	3	1	0.9	105	84	7.5	189	6.2
Awls, Perforators, and Points		29	1.6	11														29	11	1.0	40	1.3
Total of All Implements, Exclusive of the Coarse Implements	35	1,358	75.5	646	8	8	67	39	33	66	72.5	131		12	15	76	70.4	1,444	831	73.8	2,275	74.7
Hand-Axes	1	12	0.7							1	1.1	1				1	0.9	13	1	0.1	14	0.5
Total of All Pieces	55	1,796	100.0	835	11	12	100.0	76	40	91	100.0	188	2	17	27	108	100.0	1,916	1,126	100.0	3,044	100.0

seems to reveal a perceptible difference in comparison with the younger material from the Riss gravels, inasmuch as in the older series more pieces appear that have been produced by the Clactonian technique. This corresponds to the higher proportion of pieces manufactured by the stone-on-stone method established for Preservation Group 1 (compare Section 3*a* on pp. 536–542).

The over-all picture of the proportion of the individual types of tools is as follows: the coarse implements in the material of Riss age amount to approximately 8 per cent, and in the older series to about 15 per cent. The proportion of blades varies generally from 55 to 60 per cent, that of broad flakes from 5 to 7 per cent, that of points from 10 to 15 per cent, that of scrapers, side-scrapers and awls together is about 15 per cent, whereas the proportion of hand-axes is less than 1 per cent. In the collection as a whole the greatest proportion of specialized types of artifacts characterized by careful work comes from the Markkleeberg sites, as shown on table 14. In the latter category we are concerned with blades, points, and side-scrapers, which exhibit secondary working, as well as special types of scrapers, awls, and hand-axes. Although the proportion of these implements is small, they are nevertheless rather important from a typologic point of view and are almost always limited to Markkleeberg. Some of these implement types, such as the double oblique-ended blades, the gravers made on blades, and the double-shouldered points, appear here for the first time. At present, it is not possible to compare our percentages

TABLE 14

QUANTITATIVE ANALYSIS OF THE IMPLEMENT TYPES FROM THE LEIPZIG LOCALITIES

Locality:	I Markkleeberg		II Cröbern		III Zehmen		IV Miscellaneous Sites		V Total: All Sites							
	a	b	a	b	a	b	a	b	a	b	c	d	e	f	g	h
Preservation Group:	2a		2a		2a		2a		1		2a		2b		2a and 2b	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Coarse Implements	121	8.0	1	11	6	8.2	1	7.7	14	15.4	129	8.6	80	8.8	209	8.4
Blades and Flake-Blades	818	55.0	6	67	40	54.8	6	46.1	50	54.9	870	55.0	513	56.2	1,383	55.4
Single-Edged, Retouched Blades	6	0.4							2	2.2	6	0.4	2	0.2	8	0.3
Double-Edged, Retouched Blades	12	0.8			1	1.4					13	0.8	7	0.8	20	0.8
Blades with Side Curvature	3	0.2					1	7.7			3	0.2			3	0.1
Blades with Transverse Edg e	5	0.33									5	0.3			5	0.2
Oblique-Ended Blades	21	1.4									21	1.3	16	1.8	37	1.5
Double, Oblique-Ended Blades	3	0.2									3	0.2			3	0.1
Blades with Graver Blow	5	0.33									5	0.3			5	0.2
Blades with Awl-like Points	3	0.2									3	0.2			3	0.1
Total of All Blades and Flake-Blades	876	58.8	6	67	41	56.2	7	53.8	52	57.1	929	58.7	538	59	1,468	58.7
Quadrangular Flakes	14	0.9							2	2.2	14	0.9	13	1.4	27	1.1
Oval and Round Flakes	34	2.3			6	8.2			2	2.2	40	2.5	32	3.5	72	2.9
Transverse Flakes	28	1.9			4	5.5					32	2	18	2.0	50	2.0
Total of All Broad Flakes	76	5.1			10	13.7			4	4.4	86	5.4	63	6.9	149	6.0
Thick Points	12	0.8			1	1.4					13	0.8	8	0.9	21	0.85
Points made on Blades	150	10.1	1	11	10	13.7	1	7.7	10	11.0	162	10.2	62	6.8	224	8.9
Pentagonal Points	21	1.4	1	11					1	1.1	22	1.4	8	0.9	30	1.2
Points with Side Indentation	3	0.2									3	0.2			3	0.12
Single-Edged, Retouched Points	3	0.2									3	0.2			3	0.12
Double-Edged, Retouched Points	12	0.8					1	7.7	3	3.3	13	0.8	5	0.5	18	0.7
Partially Tanged Points	2	0.13									2	0.13			2	0.08
Total of All Points	203	13.6	2	22	11	15.1	2	15.4	14	15.4	218	13.7	83	9.1	301	12.0
Side-Scrapers of Various Types	72	4.8							5	5.5	72	4.5	52	5.7	124	5
Side-Scrapers with Notch on Lower Surface	4	0.3									4	0.25			4	0.16
Total of All Side-Scrapers	76	5.1							5	5.5	76	4.8	52	5.7	128	5.1
End-Scrapers	20	1.3			1	1.4	1	7.7	1	1.1	22	1.4	20	2.2	42	1.7
Double-Ended Scrapers	4	0.3									4	0.25			4	0.16
Indented Scrapers	23	1.5			1	1.4	1	7.7			25	1.6	24	2.6	49	1.96
Keeled Scrapers	9	0.6									9	0.6			9	0.36
Miscellaneous Types of End-Scrapers	42	2.8			2	2.7	1	7.7			45	2.8	40	4.4	85	3.4
Total of All End-Scrapers	98	6.5			4	5.5	3	23.1	1	1.1	105	6.6	84	9.2	189	7.6
Perforators and Awls	29	2.0									29	1.8	11	1.2	40	1.6
Hand-Axes (*Bifaces*)	12	0.8			1	1.4			1	1.1	13	0.8	1	0.1	14	0.6
Total of All Implements	1,491	99.9	9	100.0	73	100.1	13	100.0	91	100.0	1,585	100.0	912	100.0	2,498	100.0

TABLE 15

SUMMARY OF IMPLEMENT GROUPS, WITHOUT COARSE ARTIFACTS, FROM THE LEIPZIG LOCALITIES

Locality:	I Markkleeberg		II Zehmen		III Total: All Sites							
Preservation Group:	*2a*		*2a*		*1*		*2a*		*2b*		*2a* and *2b*	
	a	b	a	b	a	b	c	d	e	f	g	h
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Blades and Broad Flakes	952	70	51	76	56	73	1,016	70	601	72	1,617	71
Points	203	14.5	11	16	14	18	218	15	83	10	301	13
Side-Scrapers, End-Scrapers, Awls, and Hand-Axes	215	15.5	5	8	7	9	223	15	148	18	371	16
Total	1,370	100	67	100	77	100	1,457	100	832	100	2,289	100

with the values from other localities in Europe because no comparable investigations have ever been reported.

As has been previously stated, within the present series the coarse implements belong apart, and, in spite of the occurrence of transitional forms, they cannot be classified in terms of the usual implement types. If one omits the coarse implements, all the other tool types may easily be arranged in three principal groups: (i) blades and broad flakes, (ii) points, and (iii) side-scrapers, end-scrapers, awls, and hand-axes together. The pieces in the latter group are always trimmed, whereas those in the other two usually are not. Indeed it seems doubtful whether hand-axes should be assigned to the third group or not, for strictly speaking not all of them can be considered as flake tools. Since they comprise only a very small percentage of the series as a whole, however, they have been included. But if they had been of more frequent occurrence, it would have been better to have omitted them.

An analysis of the unrolled pieces in these three implement groups from Markkleeberg and Zehmen, as well as for all Preservation Groups from all the sites together, is presented on table 15, together with the percentage values for each group. On this table the predominance of blades is very impressive. Together with the broad flakes they constitute more than 70 per cent of the total. The two other implement groups occur in about equal proportions at Markkleeberg with respect to the total number of unrolled pieces. But, since fewer points appear among the types referable to Preservation Group *2b*, as stated above, the corresponding percentage value for all pieces from the Riss gravels together is reduced to 13 per cent, as compared with 16 per cent for the third group.

The percentage values for the older implements fit into the same general framework, notwithstanding the fact that only 77 pieces are available for analysis. Although the proportion of points (18 per cent) to side-scrapers, end-scrapers, and awls (together 9 per cent) seems to vary considerably, this may be due to the fact that these implements, as the result of heavy rolling, are no longer recognizable, and are accordingly quantitatively undervalued, as stated above. Moreover the unrolled material from Zehmen shows a similar proportion with respect to these tool groups, namely 16 and 8 per cent, respectively, and hence it does not seem justifiable to base any particular conclusions on these figures.

A graphic presentation of the relative proportions of the three main categories of implements is shown by the location of these values on an equilateral triangle in which a fixed place has been allocated to each industry (fig. 20). In this triangle the proportion of blades is counted from the base toward the apex, that of the points from the right to the left corner, and that of the side-scrapers, end-scrapers, and borers from the left to the right corner. The percentage values shown in table 15 are thus expressed. All of them fall in the uppermost part of the triangle, which represents the

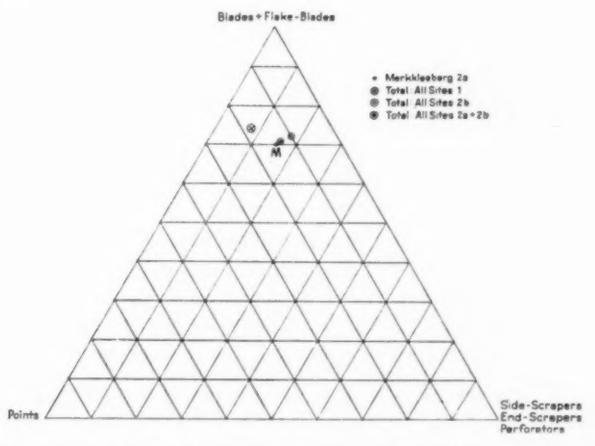


FIG. 20. Triangle diagram for the main Implement Groups.

blade industry. All the plots for the implements of the age of the Riss gravels lie near each other; only the plots for the older implements are situated slightly to the left, because here the proportion of the points is higher than that of the side-scrapers, end-scrapers, and awls, which, as previously mentioned, is probably accidental. In any case, this method of presentation convincingly shows that one must attribute to the blade tradition the material from all the localities in the Leipzig region and of all Preservation Groups. But it must be borne in mind that the over-all picture changes slightly in each case, owing to a certain proportion of coarse implements, especially with respect to the older material. Apart from this fact one may observe on the triangle that the development from Mindel-Riss Interglacial to Riss Glacial times does not show a significant change either in regard to the types of tools or to other percentage frequencies of the implement groups; rather it proceeds mainly in the direction of a refinement of the flaking methods and the development of secondary working.

THE SIGNIFICANCE OF THE LEIPZIG LOCALITIES IN TERMS OF THE LOWER PALAEOLITHIC [1]

When Jacob-Friesen first reported on his Markkleeberg finds in 1911, he could only state that they belonged to the Old Stone Age, because of the small number of pieces present at that time. It was not possible for him to assign them to one of de Mortillet's developmental stages, although he was inclined to regard the available material as Acheulian. Schmidt (1913), who later studied the greater part of the larger collection published by Jacob-Friesen (1913; with Gäbert, 1914), came to the conclusion that this material should be classified in the Early Acheulian or even in the Chellian. But, as Jacob-Friesen (1914) pointed out, the latter classification contradicts Schmidt's paleontological evidence. For in the Chellian a pronounced warm fauna with *Elephas meridionalis, El. antiquus, Rhinoceros Merckii,* and *Hippopotamus major* had been recorded, whereas at Markkleeberg the appearance of mammoth molars indicates a cold climate. Furthermore, since Schmidt placed the Chellian and the whole Acheulian to the Riss-Würm Interglacial, every attempt to bring the archaeological classification into conformity with the faunal one was doomed to failure.

Because there was no possibility of comparing the Markkleeberg finds with those from other sites in Germany, Jacob-Friesen showed his material to H. Breuil, H. Obermaier, and V. Commont in Paris and Amiens, who agreed that it was of Mousterian type. According to the state of preservation, they classified the finds in three stages and also believed that the pieces which were most heavily rolled and patinated exhibited the crudest and oldest workmanship. On the other hand, the freshest pieces were the most perfect and the youngest. The former were supposed to retain elements of the Late Acheulian, while the latter were thought to correspond to the Full Mousterian.

Jacob-Friesen (1914) took into account this appraisal of the renowned experts. However, there can be no doubt that the state of preservation, especially the degree of rolling, is not necessarily a criterion of age. Furthermore, it has also been proved that at Markkleeberg the state of preservation of the pieces and their technique of manufacture do not coincide at all. Indeed the genuine old coarse flakes are very frequently completely fresh, whereas rather perfect implements, such as the thick point (fig. 23, no. 4), are strongly rolled and deeply patinated. One must also bear in mind the fact that all those who expressed an opinion concerning the Markkleeberg material only had those pieces at their disposal which were as old as the Pleisse gravel, since the older ones of Preservation Group 1 were at that time not yet known. But the specimens from the Riss glacial gravels cannot under any circumstances be divided in the above-mentioned manner into three groups which agree as to method of working and state of preservation.

The attribution of the bulk of the Markkleeberg collection to the Mousterian contradicted the geological determination of the age of the Pleisse gravels as dating from the end of the next to last Interglacial or from the beginning of the next to last Glacial Stage, for already at that time the Mousterian was placed almost universally in the last Interglacial or in last Glacial times. Jacob-Friesen (1914) discussed this contradiction at the end of his monograph, and it has actually remained the focus of the appraisal of these sites for a long time. Wiegers (1915) maintained that the material should be ascribed to the Acheulian, especially on the basis of the geological age and the then known handaxes from Markkleeberg (figs. 72, no. 4; 74, no. 3). Whether to call the specimens Mousterian or Acheulian was the great question in the light of the state of archaeological knowledge at that time.

Therefore, one cannot entirely understand why Hauser (1927), who had actually excavated at La Micoque, referred to the Markkleeberg finds as Micoquian. At Markkleeberg all those types of implements are missing which are characteristic of the Micoquian of the type site and other localities, e.g., the Bocksteinschmiede in Württemberg. Finally, Andree (1939), who denies that the French archaeological system can be applied in Central Europe, has defined the Markkleeberg find material as belonging to a thick point (literally: *hand point*) culture, a term which he also applied to other Lower Palaeolithic finds from

[1] Since it was not possible for me to consult the relevant French and English scientific works before the actual writing of this monograph in 1944, this section is shorter than was originally planned.

Germany, e.g., Wangen, Hundisburg (compare Weigers, 1939–1940), and Neuhirschstein (where to date only a single flake has been found!). One cannot accept such a terminology, quite apart from the fact of Andree's very confused interpretation of his terms: thick points, large points and coarse points. (Actually the coarse point reproduced by him in figure 67, no. 1 is a tortoise core, which Jacob-Friesen recognized in 1914 as a nucleus and reproduced it in correct position!) Therefore, we may dismiss from further consideration in the following discussion the views expressed by Andree and Hauser.

It is perfectly understandable why French experts ascribed the Markkleeberg find material to the Mousterian. What Jacob-Friesen could show them were the coarse flakes, blades, points, and side-scrapers, including many beautifully trimmed pieces. For such a series that was composed preponderantly of flakes was at that time generally regarded as Mousterian, whereas the older stages—Acheulian and Chellian—were characterized by their hand-axes or bifaces. Older scholars, such as de Mortillet himself, even denied the appearance of any flake tools in the Lower Palaeolithic, and when later it became more and more evident that such artifacts appear in practically all the older stages of the Lower Palaeolithic, in addition to hand-axes, some scholars believed that the Mousterian and Acheulian or Chellian occurred simultaneously, and one even finds references to a Chelleo-Mousterian in the literature. A collection either lacking or very poor in hand-axes, such as that from Markkleeberg, on this basis could be regarded only as Mousterian.

To Obermaier belongs the credit for conclusively demonstrating the fact that already in the earliest French Palaeolithic, flake tools of various types occur; furthermore, that these artifacts found together with the hand-axes of the Chellian and the Acheulian exhibit a distinct development from crude to more developed forms. In other words, they cannot be simply referred to as Mousterian, but are without doubt characteristic of those older stages. It is true that almost all these implements evolve into the Mousterian, where they normally attain their highest state of perfection, but their roots are much older and are definitely recognizable in the hand-axe assemblages.

The high percentage of flake implements has long been strikingly noticeable at certain Acheulian localities in Northern France, e.g. at Cergy, at Levallois-Perret, near Paris, and at Montières, near Amiens. For this reason Obermaier (1908) referred to a substage of the Levalloisian, which was already well developed at the end of the Early Acheulian and attained the peak of its development during the Late Acheulian. Where very few hand-axes were found in comparison with flake tools, this fact was considered indicative of the Mousterian, since in the true Mousterian of France a few hand-axes occur. For this reason one can understand why the archaeological delimitation of the Acheulian and the Mousterian presented difficulties even in France.

In addition, geological evidence concerning the age of the Northern French terrace formations was not reliable until twenty years ago. Formerly the argument was based mainly on the connection of the terrace deposits with the younger and older loess. The younger loess (*ergeron*) was considered to be Post-Glacial in the sense of its having been formed subsequent to the maximum of the Würm Glaciation; similarly, the older loess (*limon rouge fendillé*) was regarded as Interglacial in the sense of being subsequent to the Riss maximum. However, in reality the younger loess was normally formed in two or three stages at the beginning and at the peak of the Würm Glaciation, and the older loess was formed during the corresponding intervals of the Riss episode. Thus the tendency was to regard the archaeological horizons in Northern France as too young. Much was attributed to the Riss-Würm Interglacial that in reality was of Riss age. On this basis Obermaier's "sub-stage of the Levalloisian" rich in flake tools, which was associated with the Acheulian (Obermaier, 1908), belonged to the Riss Glaciation. For this reason it is also understandable why Commont (1912) referred to this assemblage as Older Mousterian, since the Mousterian was known to appear in the Riss-Würm Interglacial Period.

Similar observations could be made with respect to England, which is very rich in Early Palaeolithic finds, particularly in the southeast. Here several stages of the Acheulian with hand-axes and accompanying flake implements occur in the terrace gravels of the Thames. However, it was observed that in certain of the gravel horizons flake implements alone without hand-axes were found. Other localities furnished only flake implements. On the basis of the fauna, the terrace stratigraphy and the age of the associated moraines, it was apparent that many of these assemblages were either of Riss age or even older.

The notion which was predominant until that time, namely, that the flake cultures were everywhere younger than the hand-axe cultures, was no longer tenable on the basis of these finds. On the contrary, it could be demonstrated that the existence of genuine flake or even blade cultures before the Mousterian, i.e., during the Acheulian and probably also the Chellian, had to be assumed. Breuil (1926), who paid great attention to the geological evidence bearing on the age of the archaeological horizons and was concerned with the age determination of the Somme terraces together with their covering layers, recognized the importance of this evidence, and accordingly he separated the "stage of Levallois" as a flake culture independent of the Mousterian.

As mentioned several times previously (sections 3*a* and 4 on pp. 536 and 543), one portion of the series

from the Leipzig sites exhibits technological and typological features that are ascribed to the implements of the Clactonian, whereas another portion seems to be clearly related to the Levalloisian. For this reason it is necessary to consider in some detail these two technological groups.

The *Clactonian* takes its name from a site near Clacton-on-Sea on the southeastern coast of England. Ever since 1898 rich finds of flint implements have been reported from this place, and the collections could not be arranged in conformity with the French archaeological system. Hand-axes are completely lacking, and the bulk of the material consists of coarse flakes, a portion of which are trimmed in a rudimentary manner and used as implements. At first Breuil assumed that these finds were related to some pieces of the Mesvinian of Belgium, and for this reason Warren (1922; also 1923; 1928; 1932–1933) at first referred to the culture from Clacton-on-Sea as Mesvinian. However, later Breuil (1930) suggested the name Clactonian, since in the type Mesvinian series pieces often appeared which could be regarded as primitive Levalloisian. Therefore, the term Mesvinian was reserved for the latter (Breuil and Koslowski, 1934), since genuine Clactonian artifacts only occur in the Mesvinian in rolled and reassorted condition.

Among the examples which Warren (1922) illustrated from Clacton-on-Sea there is not a single flake of the type which today is consider characteristic of the Clactonian. But he states that the flakes are mostly coarse, when pronounced bulbs and with obtuse striking angles of 110° to 130°. Breuil (1932*a*) gives the following characteristics for the Clactonian: the flakes are manufactured on the anvil by blows of block against block. They usually have a broad striking-platform, which forms a very open angle with the lower side of the piece. The striking-platform often shows small concentric rings as marks of previous blows, which did not lead to splintering. The bulb of percussion is usually thick and commences with a clearly defined cone. Not infrequently two or more cones are present which run together into a thick protuberance.

For the pieces from Clacton-on-Sea which Breuil (1932*a*) describes, the size of the striking angle varies between 127° to 145°; the most frequent size is 135°. But it appears that relatively more pieces with a very open striking angle were selected for the description. In the collection from Clacton-on-Sea at the Institute of Archaeology of the University of London, I found many pieces with angles of 100°–120°. Angles of 140° or more, at the extreme 150°, are very rare. In the collection of Mr. S. Hazzledine Warren at Laughton, near London, the majority of the flakes have angles smaller than 130°. On the seven pieces which Mr. Warren presented to me as samples, the striking angle varies quite evenly between 105° and 135°. According to Mr. Warren, the large type of bulb of percussion on the pieces from Clacton-on-Sea is caused by the fact that the flint which was used there originates in the exposed chalk, and it breaks with a very pronounced conchoidal fracture. Naturally, the striking angle should not be measured between the striking-platform and the jutting contour of the bulb, but between the platform and the longitudinal axis of the piece.

Breuil explicitly states that flakes of the Acheulian and younger stages may show similar features to those of the Clactonian, but he believes that the striking angle is less open and the bulb of percussion less pronounced, particularly in the Acheulian. In the absence of accompanying pieces, therefore, one can be doubtful to which culture coarse flakes should be ascribed.

The genuine Clactonian of Swanscombe lies at the base of the lower gravel of the 100-foot terrace of the Thames, which contains a warm fauna and which is assigned to the Mindel-Riss Interglacial Period. The archaeological horizon at Clacton-on-Sea also carries a warm fauna, in particular Hippopotamus, which has not yet been found at Swanscombe. Breuil (1932*a*) considered the deposits at Clacton-on-Sea to be older than those of Swanscombe, but this assumption has not yet been proved. According to this authority, the Clactonian has been found in the high terrace of the Somme at Abbeville in association with *Elephas meridionalis* and *El. antiquus*. In the gravels of the middle terrace of the Somme, which correspond in age with those of the 100-foot terrace of the Thames, Breuil also has demonstrated the existence of unrolled Clactonian that is of the same age as it is at Swanscombe. Further finds of Clactonian from Le Havre, Abilly (Indre-et-Loire), and La Micoque cannot as yet be precisely dated with respect to the geologic age of the artifact-bearing horizons. The same holds for a single find near Rome, which Blanc (1936) states is older than the Neanderthal-bearing deposits of Saccopastore. Clactonian finds from the Grotte de l'Observatoire in Monaco and Curson (Drôme) are probably older than Riss and younger than Mindel, according to Breuil (1932*a*). At Spiennes in Belgium Clactonian flakes together with Acheulian may be found reassorted in Riss gravels which contain Early Levalloisian *in situ*.

In Germany Clactonian type flakes have thus far been reported only as single finds (Grahmann, 1938*a*). For the flakes from Markkleeberg, Cröbern, and Zehmen a Mindel-Riss Interglacial age was assumed. A flake from Vahrholz was found in glacial gravels dating either from the Warthe advance of the Riss Glaciation or from the maximum advance of the Würm Stage. As a result of rolling and deep patination this piece differs considerably from the other Vahrholz finds, and it is definitely older than the gravels in which it was found. The flakes from Wangen-an-der-Unstrut, however, were collected *in situ*. The Wangen terrace has been assigned to the Mindel-Riss Interglacial Period, but recently Wiegers (1939), on the basis of Hese-

mann's (1937) investigations, has stated that he believes them to be of Mindel age. However, gravels dating from the Interglacial Period following the Mindel Glaciation will naturally have the same pebble content as the deposits demonstrably of Mindel age. As far as can be determined on the basis of the finds made to date, the true Clactonian of Western and Central Europe belongs in the main to the Mindel-Riss Interglacial Period.

In the series from the Leipzig sites the coarse flakes in particular, as well as some blades and possibly the thick points, exhibit a very close typological and technological relationship to the Clactonian, so much so in fact that probably they would have been assigned to the latter if they had been found by themselves. It is true that a comparison of the present material with that from Clacton-on-Sea illustrated by Breuil (1932*a*) gives the impression that they are generally smaller than a normal assemblage from Clacton-on-Sea. At the latter locality there are apparently a far greater variety and range of types than occur in the Leipzig region. For many of the Markkleeberg flakes one may find comparable examples in Breuil's figures 2 to 5 and 7. Flakes with obliquely truncated butt ends are not represented among the specimens illustrated from Clacton-on-Sea, but I have convinced myself that not infrequently in Warren's collection there occur pieces on which the rear corner of the flake has been removed by a similar and often even stronger blow than in the case of the present examples. On the other hand, oval and round flakes, as well as ones of triangular form, seem to be lacking at Clacton-on-Sea; to date the latter are known only from the Leipzig localities. The same observation applies to the elongated blade- and point-like forms which occur in our area. But the implements from Clacton-on-Sea are distinct from the Markkleeberg series in that they exhibit a more frequent use of a rudimentary type of edge trimming. However, according to Chandler (1931), in the Clactonian from Swanscombe secondary working is rare.

As characteristic of the *Levalloisian*, Breuil and Koslowski (1931–1932) mention the following features: the flake is always struck from a prepared core, either of discoidal (tortoise core) or of elongated rectangular form (cylindrical core); the striking-platform is prepared by the removal of fine trimming flakes which appear as facets on the platform of the flake (which is never true in the case of Acheulian flake implements); long narrow flakes and blades are often of frequent occurrence in the younger stages, where they gradually become thinner and smaller; in all cases the flakes are untrimmed or only slightly trimmed. Undoubtedly the latter fact must be regarded as an important difference from the Mousterian, in which carefully retouched side-scrapers and points are very numerous, and secondary working plays an important part.

Breuil has classified the Levalloisian of Northern France and Belgium in seven stages. Levalloisian I and II are never found *in situ*, but only in the gravel deposits at the base of the lower terraces. Therefore, they are believed to date from the time of the Riss Glaciation; they can be distinguished from each other only with respect to their state of preservation (*état physique*). Characteristic are rather large, thick flakes, mostly with faceted butts and always with a multi-faced upper surface. But in addition there are many blades, more rarely points and side-scrapers (compare Obermaier, 1908: figs. 117, 118, 120, 121; Breuil and Koslowski, 1932: 44, fig. 15). Levalloisian III lies at the base of the finer gravel of the lower terrace; it is only slightly rolled and abraded. It belongs to the very end of the Riss Glaciation and to the beginning of the 3rd Interglacial, and it is characterized by the reappearance of hand-axes of Acheulian type. Levalloisian IV is found unrolled in the gravels and loam of the lower terrace formed during the Last Interglacial and the beginning of the Würm Glaciation. It includes small hand-axes. The inventory of tools of the Levalloisian III and IV Stages includes more retouched pieces than do the earlier assemblages (e.g., compare Breuil and Koslowski, 1934: figs. 8 and 9). Levalloisian V lies unrolled at the basis of the Young Loess, which belongs to an early stage of the Würm Glaciation, but it still includes hand-axes of heart and triangular shape. Levalloisian VI and VII, on the other hand, which are also of Würm age, are pure flake assemblages.

In general the tools of the later stages of the Levalloisian are smaller than those of the earlier ones. Concomitantly, possibly as a result of influence from the Upper Acheulian, which is manifest by the presence of hand-axes, the number of retouched pieces increases. For this reason the typology of the developed Levalloisian often becomes very similar to that of the Mousterian, which is of the same age. But these changes occur very gradually, and hence, if the horizon of a given specimen is unknown, it is not always possible to determine whether a single piece belongs to Levalloisian III/IV or to Levalloisian V/VII on a typological basis. Furthermore, the retouched implements cannot be distinguished from those of the contemporaneous Acheulian and Mousterian.

Apart from Northern France and Belgium, Early Levalloisian has also been found in England, e.g., in the deposits of Riss age near Crayford on the Thames, and associated with a cold fauna under the 3rd Glacial coombe rock at Bakers Hole, Northfleet (Breuil, 1926). Furthermore, at Bapschild (Dines, 1928–1931) Early Levalloisian occurs in the coombe rock, and above it Upper Levalloisian appears as it does at other localities. It should be noted that in the English reports the Early Levalloisian has frequently been described as Early Mousterian (of the coombe rock). In Ger-

many the Levalloisian is also represented, as will be discussed later.

To date a comprehensive study of the French Levalloisian is lacking, and there is no single monograph describing a French Levalloisian site. The best source of information is the repeatedly mentioned study by Breuil and Koslowski (1931–1932 and 1934). In this work (Breuil and Koslowski, 1934: 266 and 278) the Markkleeberg locality is assigned to the Early Levalloisian and dated to the beginning of the Riss Glaciation. Apparently this resulted from the fact that some of the tools illustrated by Jacob-Friesen (1914) display the form and also the faceting of the butt of the Levalloisian.

1. THE YOUNGER SERIES OF MATERIAL

The Levalloisian features of part of the Markkleeberg material have already been extensively discussed in Sections 3*a* and 4 on pp. 536 and 543 of this monograph. It was shown that the normal Levalloisian flaking method may be frequently observed on the unrolled pieces from Markkleeberg, where it amounts to 27 per cent of all pieces considered in this study. However, it is true that the large, broad, and rather thick flakes, so characteristic a feature of Levalloisian I and II material from Northern France and Belgium, and also found, though rarely, at Arnum, near Hannover, are completely lacking in the Leipzig material. Most similar to them are the large, broad flakes shown in figures 34, nos. 3, 4; 35, nos. 1, 2, 3, and 6, the broad flakes in figures 49, no. 8; 50, nos. 4, 5, 6, and the large points in figures 57, nos. 1–3; 58, nos. 5, 6. In addition the Levalloisian technique is represented by numerous blades, broad flakes and points, as stated in Sections 4*d* and *f* (pp. 550 and 554); compare figures 34–44, 46, 47, 49, 50, 51, 56–59.

In general the Levalloisian artifacts in the Markkleeberg series are smaller than are the examples of corresponding age from Northern France. It is possible that this is a result of the raw material. In the Leipzig area appropriate large nodules and fragments of flint were not as abundant as they are in Northern France where the flint-bearing chalk appears everywhere and the beds of the rivers are filled with the material. For this reason, in our area prehistoric man had to be content with smaller flakes and implements. Furthermore, some of the Levalloisian tools from Markkleeberg are of special types, which in France are stated to occur only in the later stages of the Levalloisian, e.g., the long, narrow blades and triangular points, one of which is even well retouched (fig. 61, no. 9).

As has been previously stated many of the flake tools from the Leipzig sites exhibit the form and prepared upper surface typical of Levalloisian flakes. Furthermore, the characteristic features of the bone billet technique are present, but they lack faceted striking-platforms. Nevertheless, one may assign such pieces to the Levalloisian, for certainly there was not always a reason for preparing the striking-platform on the core; particularly in the case of smaller flakes this probably seemed to be unnecessary. Moreover, at the classic Levalloisian sites of Northern France not all the flakes exhibit prepared butts. Therefore, if one extends the range of the Levalloisian in this manner to include all those tools which were produced by the bone billet technique, and on which the striking-platform has been preserved, one finds that 66 per cent of the unrolled pieces from Markkleeberg fall in this category, while the figure for the rolled and unrolled material in the series from all the sites amounts to 66.6 per cent (in this respect compare tables 4 and 8 on pp. 538 and 540). If one considers the entire collection of artifacts, including those without recognizable striking-platforms, one obtains the following proportions: of the 1,491 unrolled pieces from Markkleeberg a total of 508 or 34 per cent exhibit the bone billet technique and a plain striking-platform, whereas 358 or 24 per cent have been struck with a bone billet on a faceted striking-platform, a grand total of 58 per cent of the entire series. With respect to the 2,498 rolled and unrolled implements from all the Leipzig sites, the corresponding figures are: 890 or 36 per cent and 479 or 19 per cent—a grand total of 55 per cent of all artifacts.

Finally, one must take into account the fact that in some cases the stone-on-stone technique was also employed in the Levalloisian. The few pieces produced in this manner which exhibit faceted butts demonstrate that this is true. But the stone-on-stone method on plain striking-platforms also occurs in the case of tools which should be considered Levalloisian, judging by their technique of manufacture, e.g., the specimens illustrated in figure 57, nos. 1 and 3. On this basis the proportion of Levalloisian pieces to the total series would be slightly higher than is indicated by the percentage figures given above.

The Early Levalloisian of Northern France and Belgium includes only a small proportion of retouched tools, but the figure increases in the Middle Levalloisian. Possibly this indicates an Acheulian influence, which is also reflected in the occurrence of hand-axes in certain Levalloisian levels. This same influence may likewise be detected in the series from the Leipzig sites. Not only are there a few hand-axes, but also there occur retouched side- and end-scrapers, points, awls and blades. Furthermore, certain of the unretouched blades and points which have been produced by the typical Acheulian stone-on-stone technique cannot be regarded as Clactonian (compare figs. 38, 42 [in part], 53 [in part], 54, 55, and others). Counterparts for most of these implements may be noted in the various stages of the Acheulian of Northern France. If they had not been found in direct association with Levalloisian tools, they would have been regarded as Acheulian without hesitation. Some of them have been so skillfully made —e.g., the points shown in figures 61, nos. 5 and 8;

62, nos. 8 and 9, the scrapers illustrated in figures 64, no. 8; 65, no. 3; 66, no. 1, and the blades in figure 47, nos. 11 and 12—that if they were considered by themselves, they would be assigned to the Mousterian or even to the Aurignacian. But such well-worked pieces are also known in the Acheulian.

The extent of Acheulian influence present in the Markkleeberg material may be explained in the following manner. As mentioned above, 58 per cent of the unrolled implements from the Leipzig sites exhibit features associated with the bone billet technique. The remaining 42 per cent either display the characteristics of the stone-on-stone technique or else the striking-platform is completely absent, as in the case of many end-scrapers, awls, some side-scrapers, and the hand-axes. From this total a small number of pieces must be deducted which, in spite of the fact of the technique used in their manufacture, may be regarded as Levalloisian. The *ca.* 40 per cent which remain include the tools of Acheulian and Clactonian type. The latter comprise the coarse artifacts—exactly 8 per cent as shown on table 14; in addition a small number of blades and points should be added, which makes an approximate total of 10 per cent of the tool inventory. On this basis, some 30 per cent of the material may be considered to exhibit an Acheulian influence. Of this amount 14 per cent represent the proportion of side-scrapers, end-scrapers, awls and hand-axes, while about 1.5 per cent consist of fully trimmed blades and points which do not belong to the Levalloisian series—altogether *ca.* 15.5 per cent. The remainder consists of unworked blades and points.

For the entire series from the Riss gravels at *all* the Leipzig localities, the proportion of tools either produced by the stone-on-stone technique or lacking a striking-platform amounts to 45 per cent. Some 2 per cent of these are of Levalloisian type, 10.5 per cent consist of coarse tools and other examples of Clactonian type, while 31–32 per cent may be regarded as exhibiting an Acheulian influence. Of this total, side-scrapers, end-scrapers, awls, and hand-axes amount to 14 per cent, and the other fully retouched forms to about 1.5 per cent—altogether *ca.* 15.5 per cent. Thus an average of approximately one half of the artifacts of Acheulian type are retouched.

It is doubtful whether it is necessary to consider the coarse flakes and similar forms as constituting a special Clactonian category. Indeed, one is perhaps justified in simply assigning them to the Acheulian, in which a similar striking process is found to that which occurs in the Clactonian. This seems all the more likely inasmuch as in both the Chellian (Abbevillian) and the Acheulian coarse flakes are present; incidentally they are also obtained in the Levalloisian during the process of core preparation. In opposition to this argument, it may be stated that the form of the tools which we have ascribed to Clactonian differs rather fundamentally from those of the Acheulian. It is difficult to imagine that the men who made and used the coarse quadrangular and triangular flakes as cutting implements possessed the same culture as those who produced and used the well-made blades and points, finely retouched side-scrapers and hand-axes. From this point of view the separation of a Clactonian group appears justified until new finds contribute fresh data to our knowledge of the problem.

On the basis of the present facts concerning the archaeological material from the Leipzig sites, one may therefore conclude that we are dealing with a mixture of *Clactonian,* primitive *Levalloisian* and *Acheulian.* The Clactonian comprises about 10 per cent of the total tool inventory, the Levalloisian in the broader sense of the term about 60 per cent, and the Acheulian *ca.* 30 per cent, approximately one-half of which are retouched. Within these limits, the Markkleeberg locality is characterized by the fact that, with regard to the unrolled artifacts, the proportion of first-class Levalloisian tools, i.e., those with faceted striking-platforms, is higher than in the series as a whole. Naturally the dividing lines between the various groups are vague, as a result of the nature of the material. Archaeologists always find it difficult to define precisely the various components belonging to a mixture of cultures and to assess them quantitatively. Therefore, a presentation of the proportions expressed in an equilateral triangle will be omitted.

In any event it has been clearly shown that at the beginning of the Riss Glaciation the development of the Lower Palaeolithic in the Leipzig area did not lead to the manufacture of coarse implements by the stone-on-stone method as is usual in the Clactonian, but to the production of better and finer implements made by the bone billet technique. This required more and more careful preparation of the core as well as of the striking-platform. In this manner the flake culture of the Clactonian evolved into the Early Levalloisian. To this probably developmental process there was added from outside an admixture and influence from Acheulian sources, in which a skillful method of implement manufacture with the hammerstone and careful secondary working were normal procedures.

Since the material from the Leipzig sites has not been derived from a single dwelling place, but together with the inclusion of the rolled pieces, covers the entire area of the Pleisse drainage and comprises many thousands of years, it cannot be concluded that a single tribe, or consecutive generations of a single tribe, were subjected to successive influences from the Clactonian, Levalloisian, and Acheulian cultures, united them and used all these manufacturing techniques. Rather the situation is as follows: during a period of thousands of years duration, tribes appeared at different times on the banks of the Pleisse with various skills in the production of implements; certain of these groups still em-

ployed the Clactonian technique of flake production; other more progressive tribes already used the Levalloisian method; and finally there were those who preferred careful retouch and who laboriously produced hand-axes, while the others were satisfied with a triangular flake or a thin, well-made blade.

Under such circumstances it is natural that the influences of speciàlized handicrafts were also present. These originated in the Acheulian and are particularly noticeable in the case of certain blades, points, and side-scrapers which exhibit Levalloisian characteristics and which are often retouched. Furthermore, the hand-axes seem to have been imitated. Part of them were manufactured with little skill which suggests that their producers were unused to this type of work.

Considered as a whole the material of Riss age from the Leipzig sites shows the development of a transition from the Late Clactonian to the Early Levalloisian which was influenced to a certain extent from the west by the Acheulian. In this respect the Levalloisian increment is the largest. Since it is the most evolved traits which characterize a given assemblage, it is permissible to state that the present series *is rich in blades of Early Levalloisian type associated with Late Clactonian flakes and certain Acheulian elements.* If it were desirable to refer to this mixture by a special cultural term, it would be advisable to speak of a "Pleisse Stage" (Plisnian). The process of its development is very similar to that which produced the Mousterian from the same roots toward the end of the Riss-Würm Interglacial, i.e., a combination of flake and hand-axe cultures. In both cases the equality of the sources of the two cultures makes the result very similar.

2. THE OLDER SERIES OF MATERIAL

The number of rolled pieces which exhibit a porcelain-like patination and which are very probably older than the Riss gravels is much smaller than the group discussed above. Therefore, not all the types of implements are represented, and consequently it cannot be expected that the percentage values of these and of the techniques of manufacture reflect the same accuracies which would exist if the series were larger.

As shown on table 8, p. 540 of this monograph, 62 per cent of the artifacts belonging to Preservation Group 1, in so far as they reveal their method of manufacture, have been produced by the stone-on-stone technique, which is, therefore, almost twice as frequent as among the younger series. Accordingly, the bone billet technique is less frequent and faceted striking-platforms were found only in the case of three pieces, i.e., 4 per cent (compare figure 22, no. 3). This definitely indicates a more primitive developmental stage, which is likewise suggested by a higher percentage of coarse tools; these are represented by 15 per cent. With this exception, the typology of the implements scarcely deviates quantitatively from that of the group of Riss age, as shown on table 11. Although the execution and form of the older tools generally appear more primitive, quite perfect pieces occur, such as the retouched blade and the side- and end-scraper (fig. 22, nos. 8 and 10), and the beautiful thick point (fig. 23, no. 4). The forms of these tools definitely suggest an Acheulian influence. The excellence of the workmanship even indicates that not only was there an influence exerted, but rather that temporary representatives of this western culture actually camped on the banks of

TABLE 16

CLASSIFICATION OF THE LOWER AND MIDDLE PALAEOLITHIC IN WESTERN AND CENTRAL EUROPE

Geological Stage	Hand-Axe Culture	Flake Culture	Blade Culture
Würm I		Late Mousterian Full Mousterian	Late Levalloisian
Riss-Würm Interglacial	Micoquian Late Acheulian	Early Mousterian Tayacian	Middle Levalloisian
Riss			
Mindel-Riss Interglacial	Middle Acheulian Early Acheulian	Late Clactonian Middle Clactonian	① Early Levalloisian
Mindel			
Pre-Mindel	Abbevillian	Early Clactonian	

① Older and ② Riss Glacial material from the Leipzig localities.

the Pleisse. In addition, some of the unworked blades and points could also be assigned to the Acheulian.

However, on the whole, the older material exhibits such close affinities to that from the Riss gravels that it should be regarded as the immediate predecessor of the latter. At first the new Levalloisian technique was only used by a few artificers, who produced a few rather perfect blades with it. Presumably the small increment of the Acheulian was partly due to an admixture, which only gradually developed into an influence. In spite of the significant change of the climate which took place at the beginning of the Riss Glacial Stage, no cultural change to indicate new migrations can be established in the Leipzig region. On the contrary, everything points to the fact that the area was settled during Mindel-Riss Interglacial times, or at least by the later part of this interval, and that these hunting peoples did not leave the area in spite of the change in climate, flora and fauna. On the other hand, they appear to have adapted themselves to the new conditions and to have developed their culture.

The chart (table 16) shows the stratigraphic position and cultural affinities of the Riss Glacial ② and the older material ① from the Leipzig localities with respect to the classification of the Lower and Middle Palaeolithic in Western and Central Europe as presented by H. Breuil. The possible mixtures and mutual influences of coeval stages of the three main culture groups are also indicated on the chart.

CONCLUSIONS

The Early Levalloisian was established in Northern France, Southeastern England, and Belgium by the beginning of the Riss Glacial Stage. The terrace stratigraphy of the Somme demonstrates its temporal relations to the Middle Acheulian, while the evidence from comparable deposits in the Thames Valley also shows the connection with the Clactonian. If we proceed further to the east, finds from the area of the Rhine and its tributary streams, as well as from the region of the Weser, are unfortunately nearly lacking up to the present. This is to be explained as the result of the fact that here there are no available siliceous rocks, but to the north of the limits of the greatest glaciation (Mindel) there are flints, and therefore one should expect to find Lower Palaeolithic material, especially in the terrace gravels of the Rhine and its tributary streams.

Further eastward we should mention first the finds from Arnum and Döhren to the south of Hannover. They are in the gravel of the Leine, which in part is certainly of Riss age and in part possibly younger. In addition to 30 beautiful hand-axes, points, and blades, a large typical flake of Early Levalloisian type was found at Arnum. Whether or not the blades should also be ascribed to the Levalloisian still has to be determined. Certainly a very strong influence of the Acheulian may be recognized. The new finds from the Riss gravels of the Holtemme in Grossquenstedt may be assigned to the Middle Acheulian.

An additional important site is Hundisberg north of Magdeburg, which is also of early Riss age. It has furnished a pointed hand-axe, a few points, some side- and end-scrapers, and many blades. Part of the flake tools have faceted striking-platforms and therefore are attributable to the Levalloisian. As a whole, the inventory is very reminiscent of the Markkleeberg material, and it also indicates an Acheulian admixture. It would be desirable if the finds from this site that are scattered in many collections could be studied with a view to determining their method of manufacture.

Finally, we must mention the two localities of Köchstedt on the Salzke and Wettin, near Halle on the Saale. From Riss gravels both have furnished a few artifacts which likewise belong to the Pleisse Stage, that exhibit partly faceted butts of the Levalloisian type, as well as an influence of the Acheulian.

There can be no doubt that investigations of the Riss gravels of the Northern Thuringian rivers would yield further finds, since here living conditions for the animals and men were certainly not worse than near Leipzig; furthermore, flint was available in some districts in considerable quantity.

To the east of the Leipzig localities, finds of Riss Glacial age are so far lacking. However, they should be expected, as to the north of the mountains of Central Germany there was undoubtedly an important east-west migration route for game and also for men as long as the ice-sheets of Riss age had not yet penetrated to the base of the mountains. Possibly somewhat younger is a flake-blade from Althirschstein on the Elbe (Grahmann and Mirtschin, 1933), which was found in glacial gravels accumulated during the Riss Glaciation. Investigations in the Riss terrace gravel of the Silesian rivers would be desirable. Actually some Lower Palaeolithic finds in secondary deposits from near Mährisch Ostrau might show that man was roving through the Moravian gap.

Presumably all the Riss gravels also carry implements of the Mindel-Riss Interglacial Period, just as in the case of the Pleisse gravels. Since river deposits of this interglacial are rare in Germany, the gravels of Riss age offer practically the only chance for finding Lower Palaeolithic artifacts. In addition to the older material from the Leipzig sites, only the few finds from Wangen-an-der-Unstrut can so far be regarded as of Mindel-Riss Interglacial age. The locality at Oberwerschen described by Bicker and Röpke (1938) is certainly not Mindel-Riss Interglacial, but is morainic gravel of Riss age, and among the flints collected at this place, there is scarcely a single one which could be considered with certainty as having been worked.

As far as may be determined on the basis of the finds made up to the present, a certain influence of the

Acheulian extends to the Elbe at the beginning of the Riss Glaciation. It appears to be strongest along the southern margin of the North German Plain (Döhren, Grossquenstedt). The original center of the pure flake culture cannot be established with certainty on the basis of the finds made to date. Some authorities believe that it is in the east, but it could also be in the north. The pure Clactonian of England and the pure Early Levalloisian (Mesvinian) of Belgium, for example, point to the North Sea area. Northern Germany too should be taken into consideration. The transition from the Clactonian to the Levalloisian could have taken place there, and at the same time in Central Germany.

The further development of the Levalloisian during the Riss-Würm Interglacial and up to the time of the Würm Glaciation may be traced in Western Europe. Reliable finds of this type are lacking so far in Germany. They would have to be made in the gravel of the lower terraces or in the base of the younger loess. Their presence in these horizons would be significant, for possibly it would indicate a bridge between the older blade cultures and the Upper Palaeolithic.

ILLUSTRATION AND DESCRIPTION OF THE SPECIMENS

Specimens from Markkleeberg and other sites in the Leipzig region to date have been reproduced and described by Jacob-Friesen (1911; 1913; 1914), Moschkau (1915), Wiegers (1915; 1920), Spanuth (1927), Werth (1921–1928), Braune (1928; 1934; 1938), Grahmann (1935; 1938*a*, *b*, and *c*) and Andree (1939).

In his first report Jacob-Friesen showed photographs of 13 tools. Although the half-scale reproductions do not satisfy modern requirements, they reveal the essential features of the material from the Markkleeberg site—i.e., the prevalence of blades in addition to coarse flakes with plain, high-angle striking-platforms. In a second report Jacob-Friesen (1913) reproduced a series of excellent drawings at half-scale of about 30 pieces, preponderantly blades, but also including beautiful points. The same drawings were then published together with approximately 40 others at natural size in the monograph written by Jacob-Friesen and Gäbert in 1914. To date our knowledge concerning Markkleeberg has been based on these pictures, and some of them were also reproduced in other studies.

In 1915 after the Leipzig daily papers had reported on the finds from Markkleeberg, Moschkau (1915) published four other drawings showing two broad flakes and two flake-blades at natural size. Wiegers, who was particularly interested in the geological age of the Palaeolithic localities, reproduced a hand-axe from Markkleeberg which was considered to represent a characteristic Acheulian type, and subsequently it was reproduced on several occasions. Now the first discoverer of the Markkleeberg locality, Etzold (1918), also recorded his opinion with respect to the geological age of the Pleisse-Elster gravels, and he published a drawing of a round side-scraper which he had found in Leipzig-Lindenau (he incorrectly writes Plagwitz) at the same time. With the aforementioned publications the "age of discovery" of the Markkleeberg material came to a close.

Later on Werth (1921–1928) published 8 reproductions of Markkleeberg pieces from his own collections. Hauser supplemented two of his books with references to Markkleeberg, and in a contribution written by Spanuth in 1927, 24 Markkleeberg pieces were reproduced on the basis of good photographs at three-fourths (?) their natural size. The author is not sure himself that all these pieces exhibit working, and in fact many of his illustrations are not convincing. In the contribution by Braune (1928) 13 Markkleeberg implements drawn by himself are reproduced at half natural size; among these there are characteristic coarse flakes and, shown for the first time, keeled scrapers. Later Braune (1934) reproduced a few new tools from Markkleeberg, as well as some from Cröbern and Leipzig-Lindenau at two-thirds their natural size. In his study on the age of Markkleeberg the present writer has reproduced Braune's drawings (Grahmann, 1935); later (Grahmann, 1938*a*) a coarse implement and an unprepared coarse flake were shown; then (Grahmann, 1938*b*) a hand-axe from Zehmen, together with a number of finds from secondary deposits; finally (Grahmann, 1938*c*) a tortoise core from Markkleeberg was published.

The most recent study of the Markkleeberg material was made by Andree (1939). In it he reproduces 40 pieces in his figures 59–68. Part of these were taken from Jacob-Friesen (1914), but several of the pieces shown by Andree certainly have never been worked. Furthermore, the terminology with respect to the implements is not always correct; as pointed out on pages 566–67, what Andree has called "hand points" could be almost anything.

Although more than 100 implements from the Leipzig sites have been made known through the medium of the foregoing publications, they do not do justice to the wealth of the material that is now known. It is especially difficult to get a clear picture of the series as a whole because the studies made to date are scattered, and with the exception of Jacob-Friesen's (1914) work, cover only a limited number of specimens. Furthermore, selections were made from different points of view and unfortunately these include unworked specimens as well. But above all, the illustrations in the publications that have appeared to date are not arranged according to types of implements, so that it is difficult to determine the actual appearance of various categories. However, since a knowledge of such material must be based on observation, which is the only way for a true archaeological appraisal, a large number of pieces arranged according to implement groups are

illustrated in this work. These are in turn described on the basis of the typological groupings defined in this monograph. In order to make the picture as complete as possible, some of the implements which were published earlier have been illustrated once more with new drawings and additional views.

The best picture of a culture or an industry would be obtained if one reproduced *all* the pieces at natural size. This is obviously impossible because of the size of the series from the Leipzig localities. Now, under ideal conditions it might be suggested that relatively the same number of each implement group should be illustrated—in the present case approximately one-fifth or one-sixth the total collection. But this is not feasible. With respect to some of the more numerous groups in which the typological range is not very great, for example, the untrimmed blades, such a procedure would be satisfactory, but in the case of other groups which are comprised of only a few pieces, these would be represented only by a limited number of illustrations, which would not do justice to them in view of their significance for an over-all appraisal of the whole series. For instance, this would be true of the hand-axes, the trimmed blades, points, side-scrapers, end-scrapers, and nose-scrapers. But it is precisely these rarities that must be duly considered. Therefore, they are included among the following reproductions, where they are represented relatively more frequently than pieces in the large groups of tools.

It is felt that the procedure which has been adopted for the selection of the reproductions is justified, since the statistics of the tools given in section 5 (pp. 561–566) of the archaeological part of this work provide adequate information concerning the quantitative composition of the series as a whole. Of course well-made pieces were selected in each case for the drawings. As far as the large groups are concerned their number—e.g., the blades—has not been exhausted. In each case an attempt was also made to present all varieties of a given tool type. The writer does not subscribe to the view sometimes expressed that defective pieces should also be presented, except with respect to those pieces which demonstrate especially clearly specific methods of production. For here, just as in the case of other localities, the waste material is very similar and therefore cannot be used for an over-all appraisal of the assemblage.

On figures 11 and 21–23, nos. 1–4, 6, several specimens belonging to Preservation Group 1 are shown; these exhibit a porcelain-like patination and are probably older than those contemporary with the Riss gravels of the Pleisse Valley. Figures 12 and 13, as well as figures 23 to 75, show pieces assigned to Preservation Groups *2a* and *2b*, which are as old as the containing gravel and belong to the Riss Glacial Stage. The illustrations are arranged according to implement groups. In so far as the space permitted, those pieces which have been produced by the stone-on-stone technique are in general arranged first and the others later. Moreover, the large pieces are usually found preceding the smaller ones. No attention was paid to the localities in this arrangement, but where it is not specifically stated in the caption the locality is Markkleeberg, mostly from pit Md.

A scale is mounted on all illustrations, (all pieces are shown two-thirds to four-fifths of natural size), and in each case the striking-platform is lowermost. The main drawing gives the piece lying on its lower surface, which may also be denoted as the bulbar or ventral side. Hence the upper surface is seen by the observer. Viewed in this manner there is the "left" and the "right" edge; the front or distal end is pointing away from the observer, and the back or proximal end is in the direction toward him. Secondary pictures usually give a side view and a representation of the striking-platform. For the majority of the drawings the writer is indebted to Mr. Arnold of Freiberg (Saxony).

FIG. 21. Preservation Group 1. Coarse flakes and flake-blades.

1. A thick, rectangular, coarse flake of brownish grey flint, containing bryozoa, slightly rolled, with a yellowish white patina. It has a large, plain striking-platform, a striking angle of 118°, a short cone, and a prominent bulb of percussion. The upper surface is marked by a single rib running from the right edge towards the distal end. An area of nodular cortex remains on the surface to the right of the rib. The edges exhibit indentations made both from above and below; on the distal edge, mostly from below. There are also traces of recent rolling. This specimen has been described and illustrated by Grahmann (1938*a*).

2. Cröbern. A rectangular, coarse flake of heavily rolled flint. The flint is very light, apparently patinated through the whole substance, with an outer covering of grey-brown. It probably belongs to Preservation Group 1. The striking-platform has been broken off, leaving a large, plain base. There are two cones, close together, which join in a prominent bulb. The striking angle is 115°. Longitudinal flakes have been detached from the upper surface. The edges have been rolled since the formation of the outer grey-brown patina. This specimen has been described and illustrated by Grahmann (1938*a*).

3. Zehmen. A thick, rectangular, coarse flake of grey flint, slightly rolled and mostly patinated milky white. It has a large plain striking-platform, a striking angle of 103°, a short cone and a short prominent bulb of percussion. The lower surface is curved while the upper surface exhibits one main diagonal rib and several secondary ones. The distal and side edges show over-all indentations and more recent traces of rolling. This specimen has been described and illustrated by Grahmann (1938*a*).

4. A thick, rectangular flake of grey-brown flint, heavily rolled and then heavily patinated in a porcelain-like fashion. Following the patination the specimen has again been rolled. It has a large, plain striking-platform, and a striking angle of 115°. The upper surface shows a single rib running toward the left distal extremity, and an area of original cortex at the left rear. The edges are badly rolled but still show a few indentations.

5. A triangular flake of grey flint, heavily rolled, then patinated yellowish white, and later superficially colored olive green. It was made by the stone-on-stone technique, and has a large, plain striking-platform, a striking angle of 115°, a cone, and a bulb of percussion. The upper surface shows two longitudinal ribs. Both edges are marked by old indentations, made mostly from the upper surface, and have been rolled.

6. A single-ribbed, thick, rectangular flake of very finely grained, fresh-water quartzite, which has been heavily rolled. The specimen has a very thick brown patina and probably belongs to Preservation Group 1. It has a slightly prepared striking-platform with a striking angle of 110°, and a prominent bulb of percussion. Both edges exhibit indentations made from the upper and lower surfaces, and are rolled.

7. A single-ribbed flake-blade of grey flint with a thick yellowish white patina. The specimen had been heavily rolled prior to patination. The heavily rolled striking-platform was probably originally unprepared, and was made by the stone-on-stone technique. There is a striking angle of 95°, and a short, prominent bulb of percussion. The two edges exhibit over-all indentations, chiefly on the upper surface, and also show the effects of recent rolling.

8. A flake-blade of grey flint, rolled and thickly patinated yellowish white. The striking-platform has been broken off but part of a prominent bulb of percussion is still preserved. The upper surface has a fork-like rib which runs toward the distal end. The right edge shows over-all indentations and traces of recent rolling while the left exhibits a purposely deepened curvature.

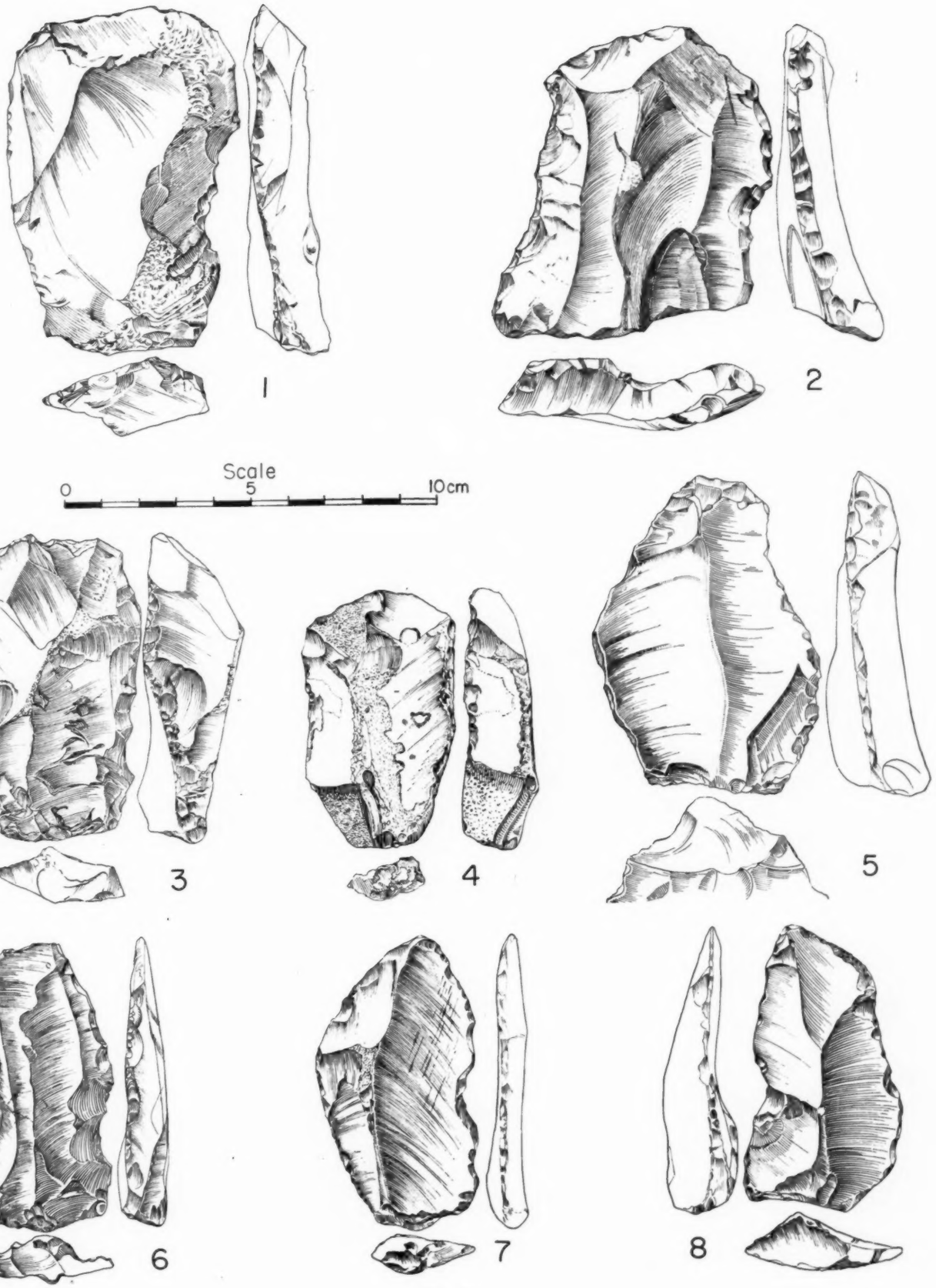


FIG. 21

FIG. 22. Preservation Group 1. Blades and end-scrapers.

1. Cröbern. A blade of grey flint, rolled and then patinated yellowish white; later this patina was superficially colored ochreous yellow. It has a small striking-platform at a right angle to the long axis. The lower surface has a slight curvature. The upper surface has one main rib and several flake scars which run inward from the left edge. On the right, a flake scar runs from the rear toward the distal extremity which is steep and blunt. Originally both edges probably exhibited indentations, but have been heavily rolled following the patination.

2. Zehmen. A blade of grey flint, rolled, and then patinated mostly grey-white. It has a small striking-platform, probably originally with a few facets, and a striking angle of 110°. The upper surface shows two longitudinal ribs. Both edges exhibit coarse indentations, made mostly from above, and more recent traces of rolling.

3. Cröbern. A thick blade of grey flint, rolled, then patinated creamy white, and later colored olive brown. It has a small striking-platform, with a few facets, which is at a right angle to the long axis. The upper surface shows two longitudinal ribs. Both edges exhibit coarse indentations, made from above and below, and more recent traces of rolling. This specimen has been illustrated previously by Braune (1934: 375).

4. Zehmen. A blade of flint, heavily rolled, later apparently patinated white throughout, and finally covered with a rusty brown color. Originally the striking-platform was probably faceted and rectangular. It was made by the bone billet technique, and exhibits a projection at the bulb. The whole specimen shows a peculiar distortion with an *S*-curvature of the lower surface. The upper surface exhibits a slightly pronounced main rib. The distal extremity is a more recent, round projection, probably formed as the result of frost action. Both edges exhibit older indentations and more recent traces of rolling.

5. Zehmen. A narrow blade of grey flint, rolled, then patinated white, and later superficially colored ochreous brown. It has a very small striking-platform and weak bulb of percussion. The lower surface shows a slight curvature; the upper surface, one main rib. Both edges exhibit coarse indentations, mainly on the lower surface, and more recent traces of rolling.

6. Zehmen. A flake-blade of flint, slightly rolled, with a heavy white patina. It has a faceted striking-platform at a right angle to the long axis, and one rib on the upper surface. Both edges exhibit over-all, short retouch and indentations, mostly on the lower surface.

7. A thick flake-blade of dark grey flint, almost unrolled and patinated milky white. It was made by the stone-on-stone technique, and has a prepared striking-platform, a cone, a short prominent bulb, and a striking angle of 110°. The upper surface exhibits one main rib toward the distal end, and an area of nodular cortex. Both edges show a few indentations.

8. Zehmen. A thick blade of banded, grey flint, slightly rolled, with a thick white patina which was later colored slightly yellow. The striking-platform has been broken off recently. The upper surface exhibits two main ribs. On the left there is over-all retouching in several steps; on the right, over-all, simple retouching.

9. Zehmen. A pointed blade of grey-brown flint, rolled, and covered mostly with a yellowish white patina. It has a small, plain striking-platform, and a striking angle of 100°. The lower surface exhibits a slight curvature; the upper surface, two ribs which join toward the distal extremity. The point was broken off in antiquity. Both edges show coarse indentations, usually made from below, and more recent traces of rolling.

10. Zehmen. An end-scraper of grey flint, slightly rolled and then patinated white. The specimen has been made from a thick, single-ribbed flake. The striking-platform has been removed by flaking directed toward the upper surface, but the bulb of percussion is still partly present. The lower surface shows a slight curvature. The left edge exhibits a few indentations made for use. The right edge also shows indentations which change into steep retouch towards the distal extremity. The retouching has been carried out particularly carefully at this end of the specimen and forms a scraper edge. The projection on the distal end at the left apparently has been left purposely above a secondary rib which was tapering off there.

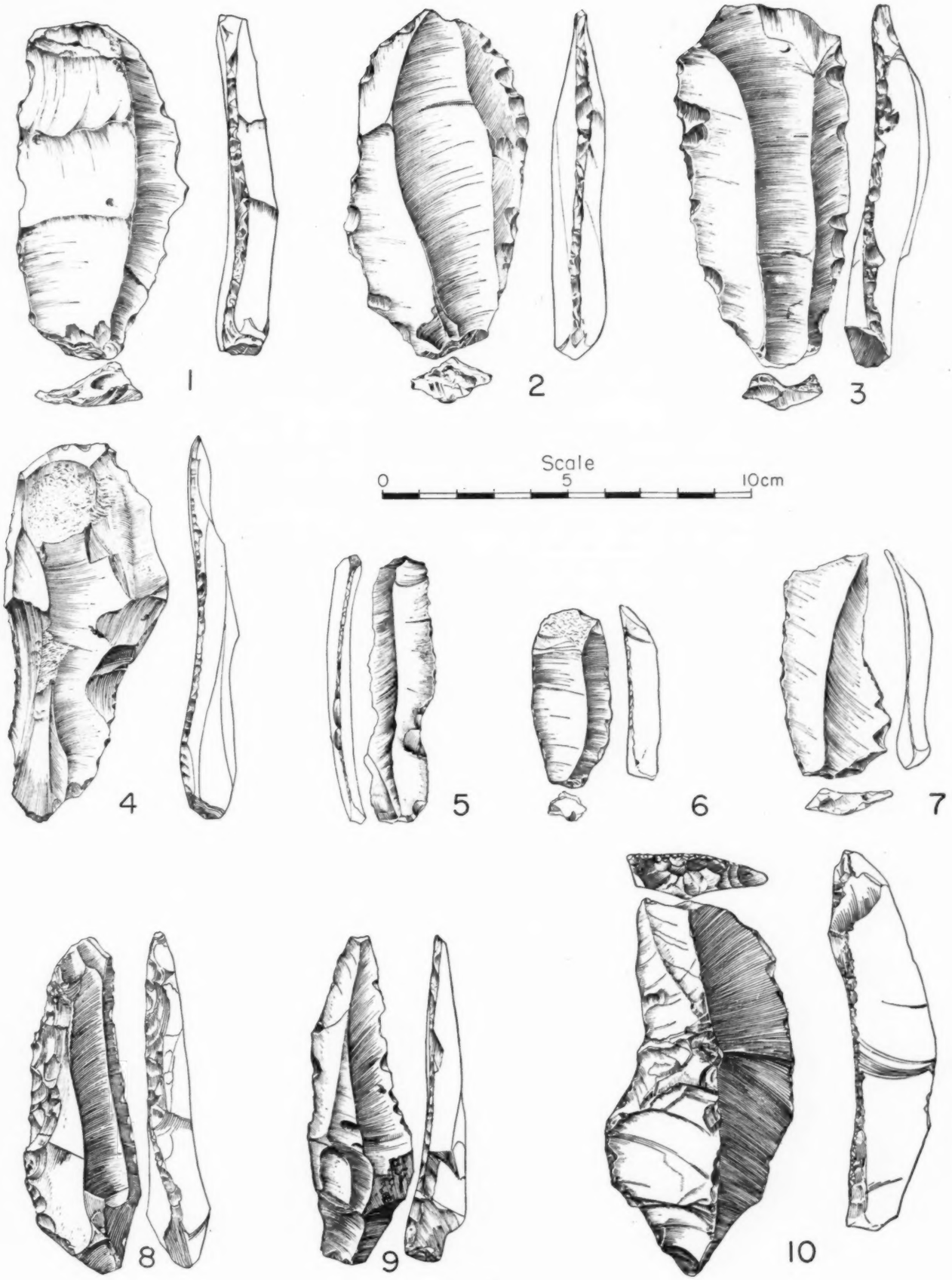


FIG. 22

FIG. 23. Miscellaneous artifacts.

1. Zehmen. A point of flint which is slightly rolled and patinated grey-white. It has a faceted striking-platform on the right in the rear, and a striking angle of 110°. The upper surface exhibits a single rib, and the right edge, fine indentations (Preservation Group 1).

2. Zehmen. A beaked side-scraper of grey flint, heavily rolled and patinated grey-white. The specimen has been made from a flake-blade. The striking-platform has, however, become almost unrecognizable as the result of rolling, although the bulb of percussion is still easily seen. The upper surface shows several scars from blows struck at the edges. The left edge exhibits coarse indentations, and more recent traces of rolling, mostly on the lower surface; the right edge shows careful retouching which is, however, heavily scoured (Preservation Group 1).

3. A small point of grey flint, heavily rolled, with a thick white patina. It has been made from a flake, the striking-platform and bulb of percussion of which have been removed. The upper surface shows a main middle rib, surface retouching on the left, and some nodular cortex toward the left distal end. The two edges evidently originally exhibited short retouching, the finer part of which has been lost as a result of rolling (Preservation Group 1).

4. A large point of flint, rolled, then apparently patinated white and later colored ochreous brown. The specimen has been made from a flake, the striking-platform and bulb of percussion of which have been entirely removed by several blows. The upper surface has been prepared all over by secondary flaking from the edges in the same manner as a biface. This surface flaking grades toward the edges into fine retouching which reveals, especially on the right edge, and left distal end, a very skillful technique. This specimen is unusual among the implements from these sites. It undoubtedly belongs to the Acheulian. Similar specimens are shown by Kelley (1937: figs. 1, 4, 6, 8 and 13). (Preservation Group 1.)

5. A thick, coarse flake of spotty, light and dark grey flint with a light, yellowish brown patina. It is unrolled, with a large, plain striking-platform, a projecting cone, a prominent bulb, and a striking angle of 125°. The upper surface shows few flake scars, and is to a large extent covered with nodular cortex. The right edge is straight with indentations from both surfaces.

6. Cröbern. A straight-edged side-scraper of grey flint, heavily rolled and patinated yellowish white. It has been made from a flake the percussion marks of which are still recognizable. The upper surface has several scars made by the detachment of flakes along the edges and the rear. The left edge was partly blunted, apparently on purpose. The right edge exhibits over-all, coarse retouching on the upper surface, and traces of recent rolling (Preservation Group 1).

7. A tortoise core of grey-black and olive-colored flint, almost unrolled and slightly patinated. This specimen has been made from a fragment of a dense flint nodule, the grey-black cortex of which is still partly preserved on the strongly curved upper surface. Side blows have given the nodular fragment a somewhat wavy cutting edge around almost the entire core. On the upper surface the flake scars are short. The lower, flatter surface of the core has been worked all around its edge, and the flake scars cover it evenly. The cutting edge shows retouching in some places along its upper surface, providing faceted striking-platforms for the detachment of flakes. This tortoise core has been described by Grahmann (1938*c*).

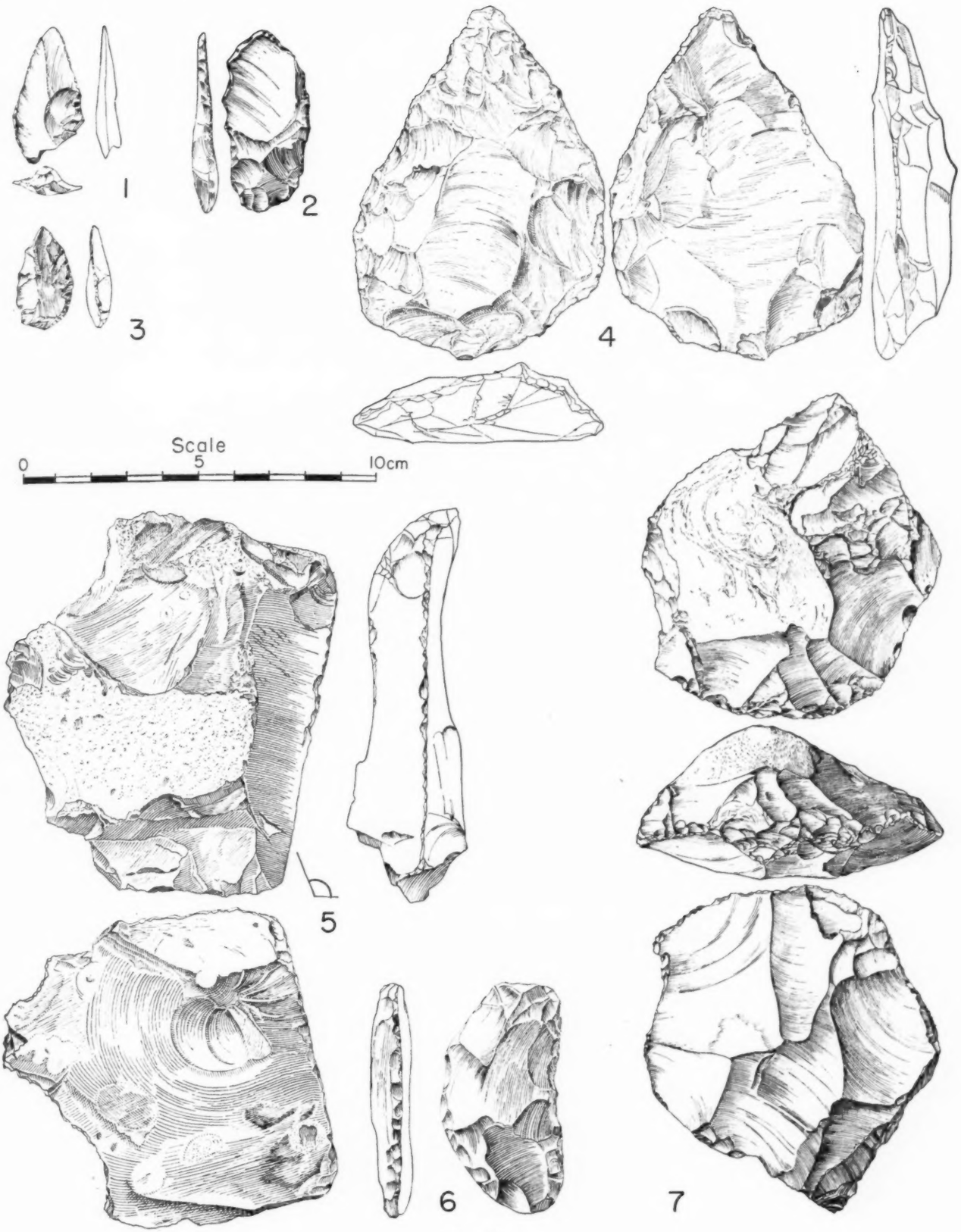


FIG. 23

FIG. 24. Coarse flakes.

1. A large flake of banded grey flint, patinated light brown and unrolled. The striking-platform is near the cortex. There is a striking-platform, a prominent cone and bulb, and a striking angle of 110°. The upper surface shows three striking-platforms near the nodular cortext at the rear. Both edges exhibit over-all indentations or very simple retouching, executed from above.

2. A large flake made of light grey flint, unrolled and slightly patinated. It has a plain striking-platform, a cone and thick bulb, and a striking angle of 115°. The upper surface shows several flake scars. The left edge is steep and unworked; the right exhibits over-all indentations made from above. The distal extremity shows simple retouching. The right edge was broken off in antiquity.

3. A flat, coarse flake of grey flint, patinated light brown and unrolled. It has a plain striking-platform, a striking angle of 110°, and a double rib on the upper surface. The left edge is steep and shows indentations made from above and below. The right and distal edges exhibit over-all indentations executed from above.

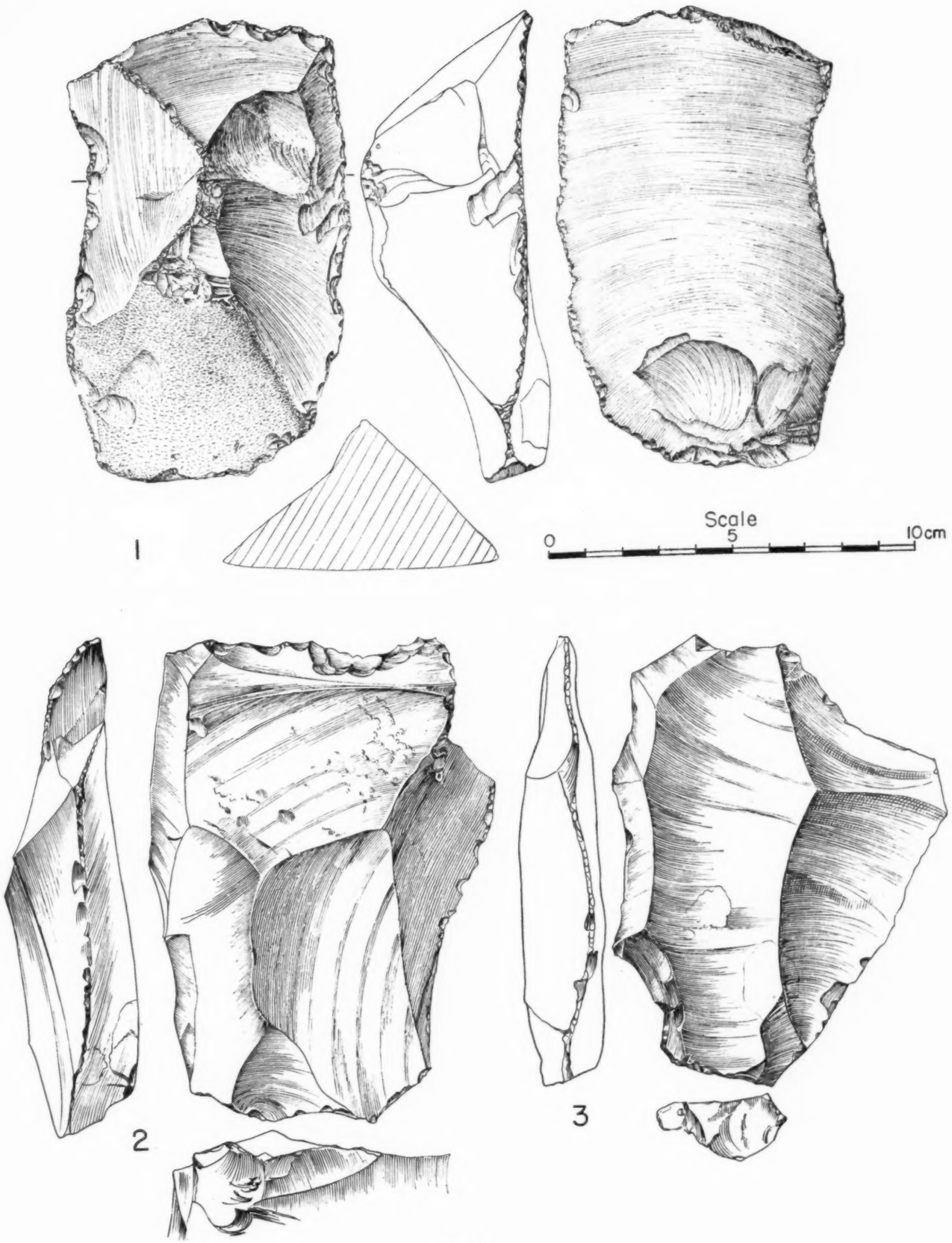


FIG. 24

FIG. 25. Coarse flakes.

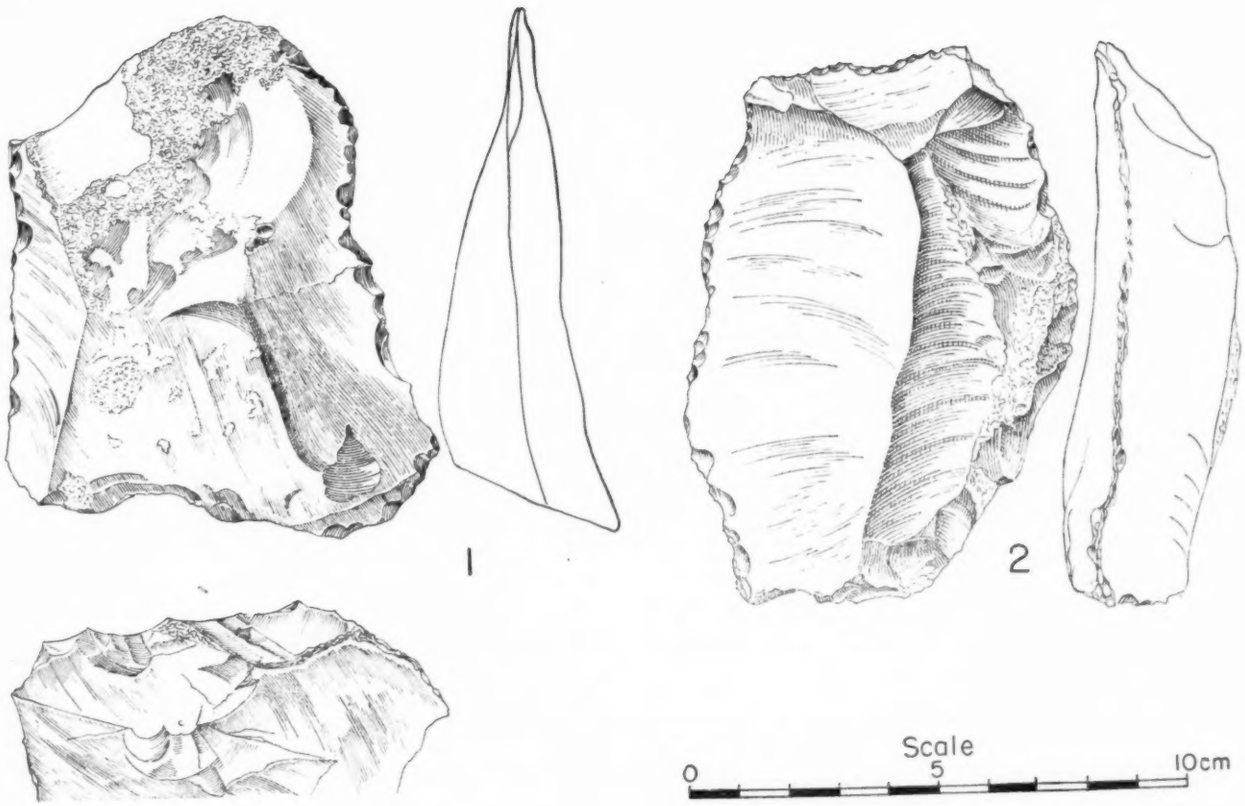
1. A coarse flake of grey flint, patinated ochreous yellow and unrolled. It has a large, plain striking-platform, two prominent percussion cones which join in a thick bulb, and a striking angle of 120°. The upper surface shows mostly the original cortex of the flint fragment. Both edges exhibit over-all indentations made from above.

2. A coarse flake of grey- and olive-colored, unrolled, flint. It has a slightly faceted striking-platform, a striking angle of 95°, and a pronounced percussion cone made by the stone-on-stone technique. Cortex is visible on the right side of the upper surface which has a middle rib that forks at the distal end. The left edge and the distal end of the specimen exhibit over-all indentations.

3. A quadrangular, coarse flake of grey flint, unrolled, with a thick brown patina. It has a large, plain striking-platform, a projecting percussion cone, and a striking angle of 105°. The upper surface exhibits nodular cortex on the left distal end and is double-ribbed. The distal and left edges are unworked. The right edge shows over-all indentations made from above which form a neat retouch, so that the specimen might also be considered a right side-scraper.

4. A quadrangular, flat, coarse flake of light grey flint, slightly patinated and unrolled. It has a plain striking-platform, a short cone, and a striking angle of 120°. The upper surface shows four flake scars. All of the edges exhibit over-all indentations, and the right rear corner has been blunted by a blow from above.

5. A quadrangular, coarse flake of grey flint, heavily patinated brown, and unrolled. It has a plain striking-platform, a prominent bulb, and a striking angle of 115°. The surface near the original cortex is very coarse. Both edges exhibit over-all indentations, made mostly from below on the left, and from above on the right.



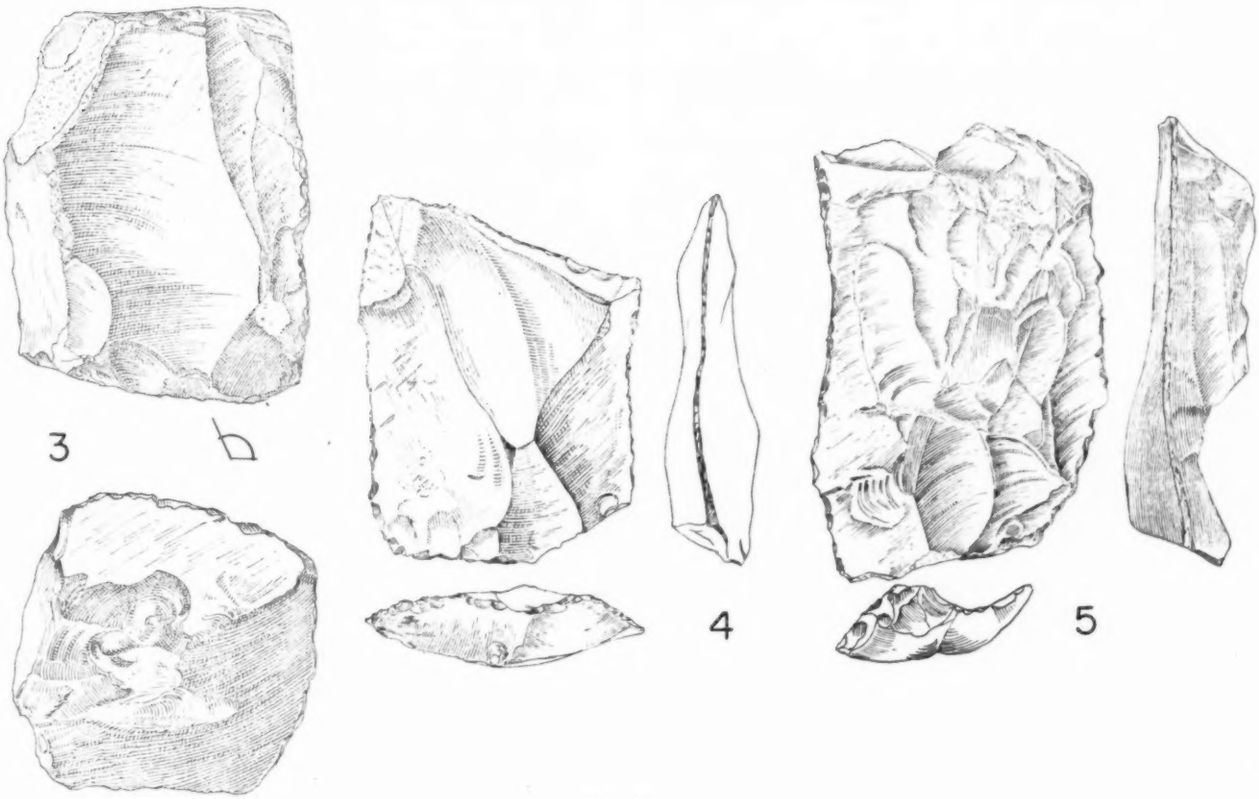


FIG. 25

FIG. 26. Coarse flakes.

1. A quadrangular, coarse flake of grey flint, patinated light brown, and unrolled. It was made by the stone-on-stone technique, and has a large, plain striking-platform, and a striking angle of 115°. The upper surface has one rib which forks toward the distal end. The left edge exhibits indentations made from below; the right and distal edges, from above.

2. A quadrangular, coarse flake of light grey flint, only slightly patinated and unrolled. It was made by the stone-on-stone technique, and has a large, plain striking-platform, and a striking angle of 130°. The rear edge towards the right of the specimen was removed by a heavy blow from the upper surface. The left edges show indentations made from above and below.

3. A trapezoidal flake of spotty grey flint, unrolled and only slightly patinated. It has a large, plain striking-platform, a prominent cone, a thick bulb of percussion which occupies the entire lower surface of the flake, and a striking angle of 125°. The upper surface retains some cortex on the right side at the rear, and is crudely trimmed by blows along the edges. The left edge exhibits very simple retouching on the upper surface accentuating the curvatures. The distal edge also shows indentations on the upper surface.

4. A quadrangular, thick, coarse flake of dark grey flint, rolled and patinated olive green. The originally large, plain striking-platform has been narrowed by a thinning blow struck toward the upper surface. There is a cone and prominent bulb of percussion, and a striking angle of 125°. The upper surface has been crudely retouched from around the edges. Both edges show over-all indentations or simple retouch, and are heavily rolled.

5. A quadrangular, coarse flake of spotty, grey flint, slightly patinated light brown, and unrolled. It has a rather large striking-platform, a cone, a flat bulb with a projection, and a striking angle of 115°. The upper surface still retains some nodular cortex. It is otherwise unworked. The right edge exhibits indentations made both from above and below. The distal edge shows over-all, simple retouching on the lower surface, indicating that it was used.

6. A small, coarse flake of spotty, dark grey flint, patinated brown, and unrolled. It has a large, plain striking-platform, a projecting cone and short bulb, and a striking angle of 120°. There are two longitudinal ribs on the upper surface. The right edge is sharp toward the distal end, and blunt toward the rear. The left edge is sharp, and shows indentations.

7. A quadrangular, coarse flake of banded, grey flint, patinated brown, and slightly rolled. It has a large, plain striking-platform, a prominent bulb without a cone, and a striking angle of 130°. The upper surface is a single unworked flake scar. The left edge is blunt. The remaining edges show traces of rolling.

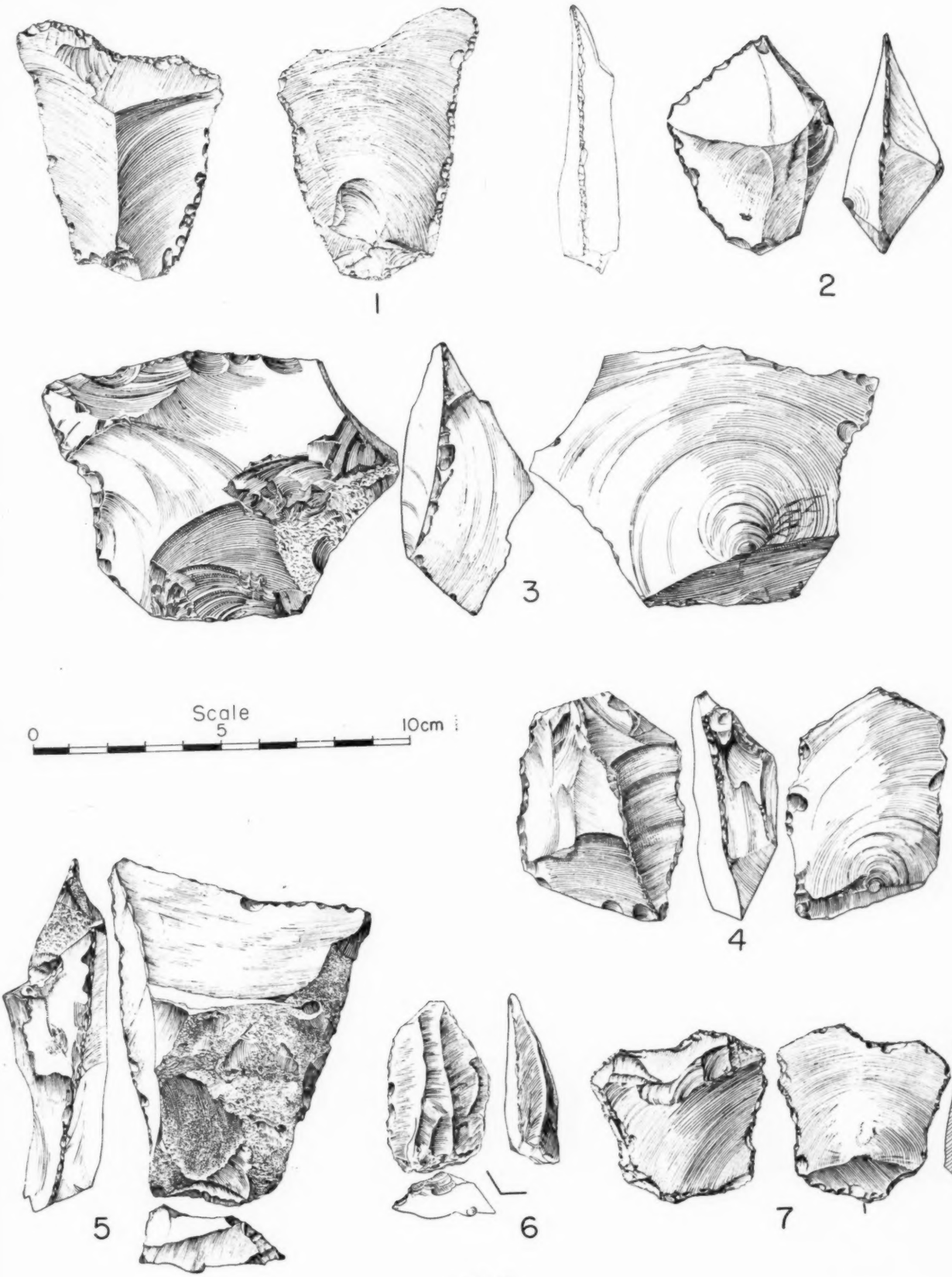


FIG. 26

FIG. 27. Coarse flakes.

1. A coarse transverse flake of grey flint, unrolled and patinated an olive color with traces of white on some surfaces. It has a large, plain striking-platform with a striking angle of 120°. Two heavy stone-on-stone blows have resulted in cones which join in a thick bulb that occupies the entire lower surface. The upper surface shows a few accidental scars. The right rear corner of the specimen has been removed by a strong blow struck towards the distal end, the edge of which exhibits many indentations (from the left toward the right) in the center on the upper surface. On the right edge, the retouching has been executed from above toward the projection, so that a scraper edge has developed here.

2. A triangular, coarse flake of bryozoa-carrying flint, unrolled, with little patina. It has a plain striking-platform, was made by the stone-on-stone technique, and has a striking angle of 115°. The right rear corner has been trimmed obliquely. The upper surface is crudely prepared and shows some nodular cortex. Both edges exhibit indentations.

3. A coarse transverse flake of spotty, light grey flint, unrolled and patinated ochreous brown. It has an extended, plain striking-platform, was made by the stone-on-stone technique, has a cone and bulb which cover its lower surface, and a striking angle of 110°. The upper surface was formed by the detachment of three flakes. The left edge is blunt; the diagonal, right edge shows over-all very simple retouching along the upper surface. The flake may be held with the right hand, with the index finger on the long basal surface.

4. A small, trapezoidal, coarse flake of spotty, dark grey flint, unrolled and scarcely patinated. It has a large, extended, plain striking-platform, made by the stone-on-stone technique with a cone and prominent bulb, and a striking angle of 120°. Some white nodular cortex still remains on the left side of the unworked upper surface. The distal edge exhibits some slight indentations, and the right edge has been retouched into a curvature on the upper surface.

5. A triangular, coarse flake of unrolled, spotty, grey-black flint. It has a large striking-platform, a prominent cone, and a striking angle of 120°. The upper surface exhibits several flake scars, nodular cortex at the distal end, and a missing right rear corner. Both edges show fine indentations, made mostly from below.

6. A pentagonal, coarse flake of grey flint, patinated ochreous yellow, and unrolled. It has a plain striking-platform with a double point of impact, a strongly projecting percussion cone, and a striking angle of 110°. The upper surface has many scars made by strong blows. The edge at the right rear has been made oblique by a strong blow struck from above. All edges show over-all indentations made from above.

7. A pentagonal, coarse flake of grey flint, unrolled and patinated brown. It has a large, plain striking-platform, a striking angle of 115°, no cone and a flat bulb. The right edge shows over-all indentations, the left edge only at the distal end.

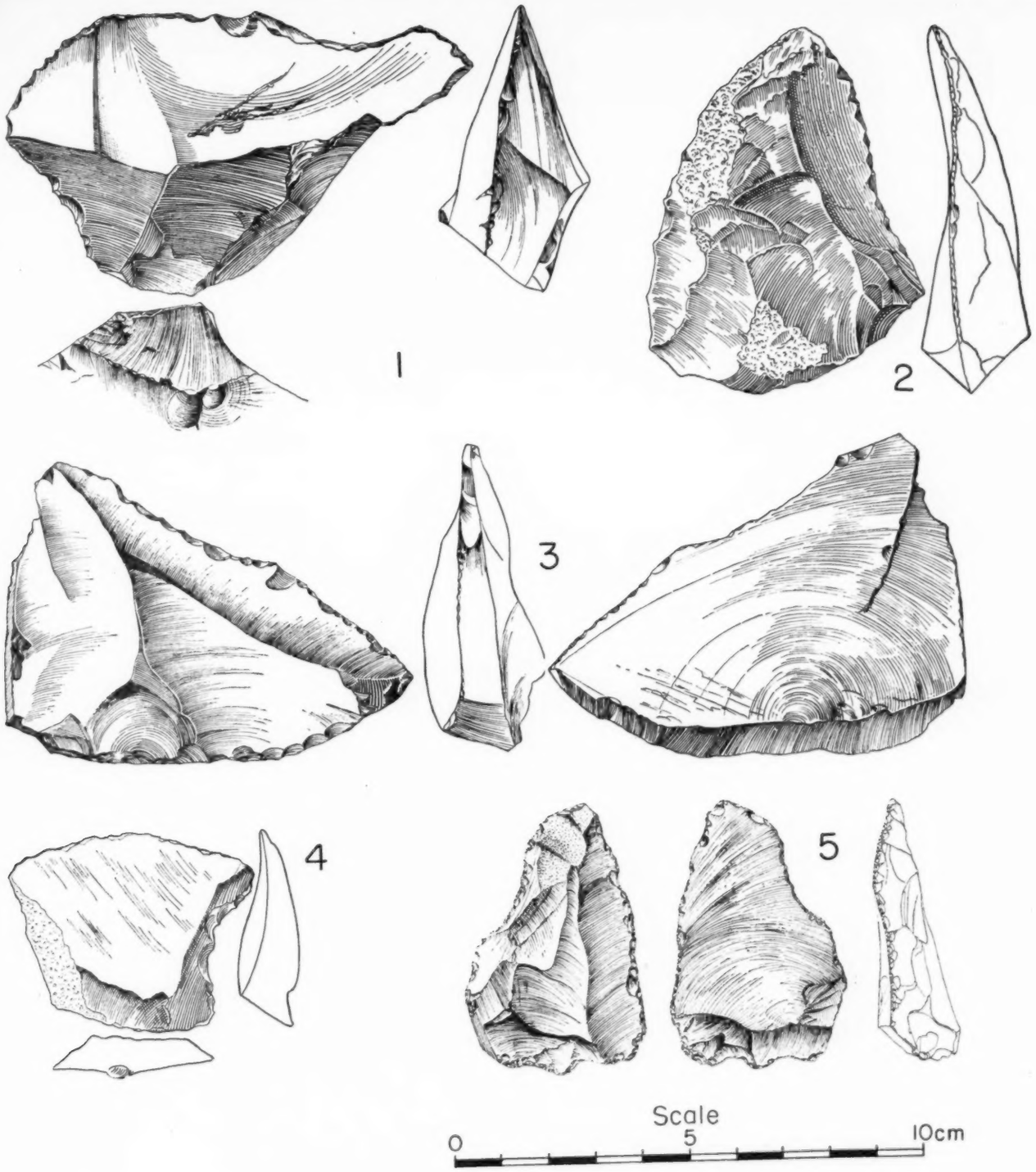


FIG. 27

FIG. 28. Coarse flakes.

1. A triangular, coarse flake of light grey flint, little rolled and slightly patinated light brown. It has a large, plain striking-platform, made by the stone-on-stone technique, and a striking angle of 120°. A short percussion cone and a thick bulb occupy the entire lower surface. The right corner of the striking-platform has been flaked off at an obtuse angle. The upper surface has a curved middle rib. The right edge exhibits indentations made from above; the left one, indentations made mostly from below. In addition, the specimen shows traces of abrasion.

2. A triangular, coarse flake of translucent, grey flint, unrolled and slightly patinated. It was made by the stone-on-stone technique, and has a plain striking-platform, a thick bulb, and a striking angle of 120°. The upper surface has a single rib. Both cutting edges exhibit over-all simple retouching. A curved indentation is present on the rear right edge of the upper surface.

3. A very small, coarse flake of unrolled flint. It has a striking angle of 110°, and a distinct small cone. The right rear corner of the flake has been removed. In spite of its small size the specimen shows all of the features of the large triangular, coarse flakes.

4. A large, coarse, triangular flake of mottled, light grey flint, slightly rolled and patinated. Probably the striking-platform was originally unprepared; later, as the result of several blows on the lower right edge, it was retouched for use. One part of the thick butt end is still apparent, since it extends in a thick rounded projection. The upper surface of the flake exhibits a mid-rib, and both edges show over-all chipping on both surfaces. This specimen has already been described by K. Braune (1928: pl. 10, fig. 1).

5. A triangular, coarse flake of spotty, grey flint, unrolled and slightly patinated an olive color. It was made by the stone-on-stone technique, and has an extended, plain striking-platform, a cone, a thick bulb, and a striking angle of 125°. The upper surface exhibits three ribs joining in the center. The right rear corner has been flaked off at an obtuse angle. Both edges show indentations, besides which there are numerous traces of abrasion.

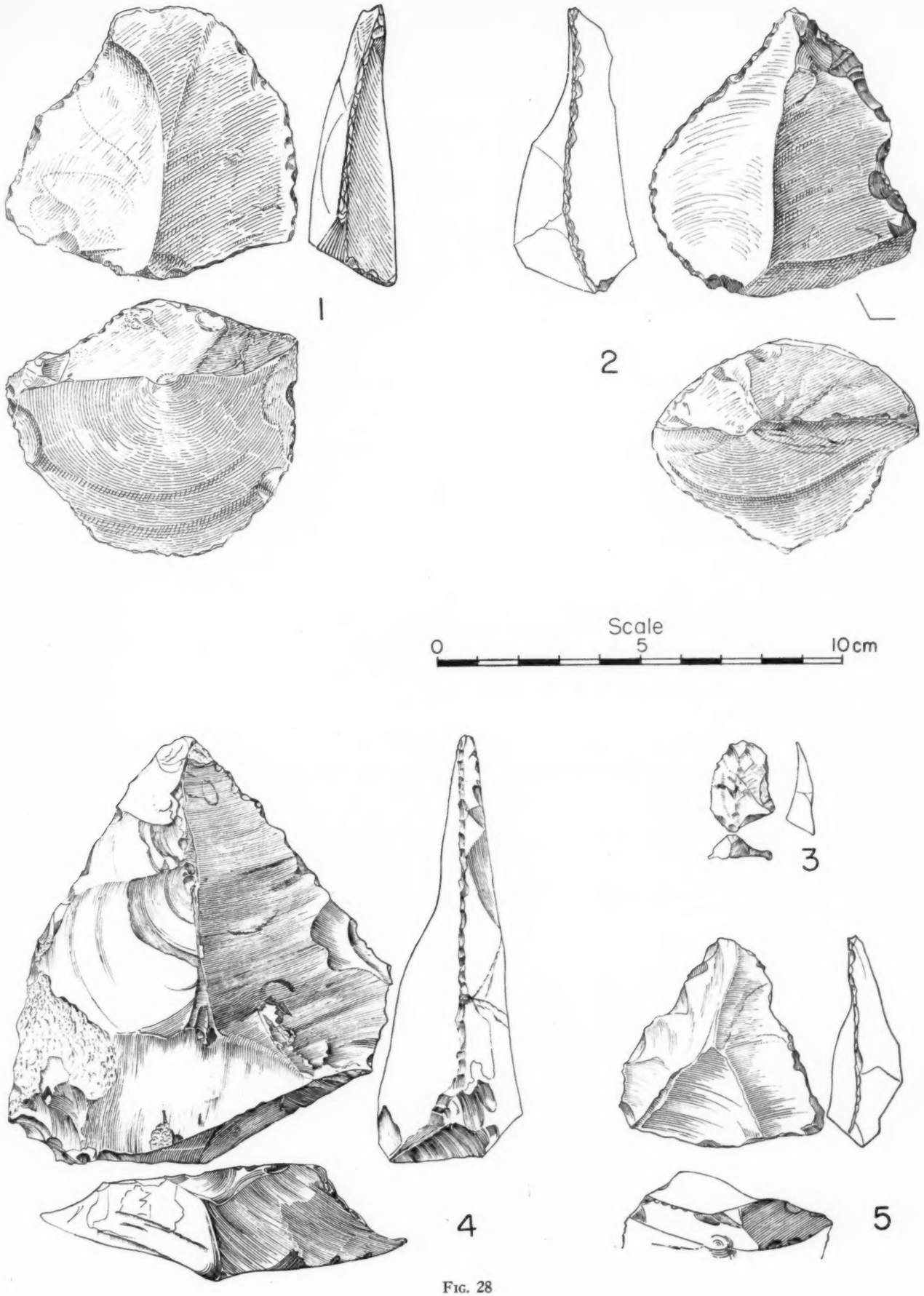


FIG. 28

FIG. 29. Coarse flakes.

1. A thick, triangular, coarse flake of grey, partly banded flint, unrolled and slightly patinated. It was made by the stone-on-stone technique, and originally had a large striking-platform; it has a cone, a thick bulb, and a striking angle of 110°. The right rear corner of the flake has been removed by a strong blow, producing a triangular shape which is accentuated by a single middle rib. Both edges show over-all indentations, predominantly on the upper surface.

2. A thick, triangular, coarse flake of spotty, light grey flint, patinated slightly yellow, and unrolled. It was made by the stone-on-stone technique, and originally had a large striking-platform; it has a projecting cone, a thick bulb, and a striking angle of 100°. The right corner has been removed by a strong blow from above, producing a triangular base, at a right angle to the rib, which is larger than the rest of the striking-platform. Thus, the whole flake has received a new alignment whereby the real striking-platform lies at the side, on the left. Both edges show over-all indentations, mostly on the upper surface.

3. A small, coarse transverse flake of grey flint, slightly rolled and patinated yellowish brown. It was made by the stone-on-stone technique, and has a plain striking-platform, a short cone with an adjoining bulb, and a striking angle of 130°. The upper surface shows several, probably accidental, flake scars, and some cortex on the right rear. All edges exhibit indentations. It appears that the point on the right was used. If the specimen is set up on the longitudinal axis of this point it corresponds to the triangular, coarse flakes.

4. Cröbern. A thick, triangular, coarse flake of grey flint, rolled and slightly patinated ochreous brown. It has a plain striking-platform, a cone and bulb, and a striking angle of 115°. The right rear corner of the flake has been removed by a blow from above, so that a pseudo-base developed, giving the specimen a triangular form. The upper surface shows two longitudinal ribs parallel to flake scars. Both edges have over-all simple retouching, executed from above.

5. A pointed, triangular, coarse flake of light grey flint, colored ochreous brown on the upper surface, patinated and unrolled. It was made by the stone-on-stone technique, and has a plain striking-platform, a cone, a bulb, and a striking angle of 125°. The upper surface has one main rib. The left edge shows over-all indentations on the upper surface; the right edge has been retouched from below, and could have served as a support for the index finger. Another retouched area, on the left edge in the rear, probably formed a thumb support.

6. A pointed, thick, coarse flake of light grey flint, rolled and slightly patinated ochreous yellow. It was made by the stone-on-stone technique, and has a small, plain striking-platform, a short cone, a prominent bulb, and a striking angle of 135°. The upper surface has a single main rib and shows strong percussion ripples from both edges. The right edge exhibits many indentations; otherwise, the specimen shows strong traces of rolling.

7. A pointed, triangular, coarse flake of translucent, grey flint, unrolled and slightly patinated. It was made by the stone-on-stone technique, and has a large, plain striking-platform, a short cone with an adjoining bulb, and a striking angle of 120°. The upper surface has one main rib. Both cutting edges show fine, over-all indentations.

8. A pointed, triangular, coarse flake of translucent, dark grey flint, unrolled and slightly patinated. It was made by the stone-on-stone technique, and has a plain striking-platform, a short cone and bulb, and a striking angle of 135°. The upper surface has one main rib and some nodular cortex on the right rear. The left rear corner of the specimen has been removed. The left edge exhibits slight indentations on the lower surface.

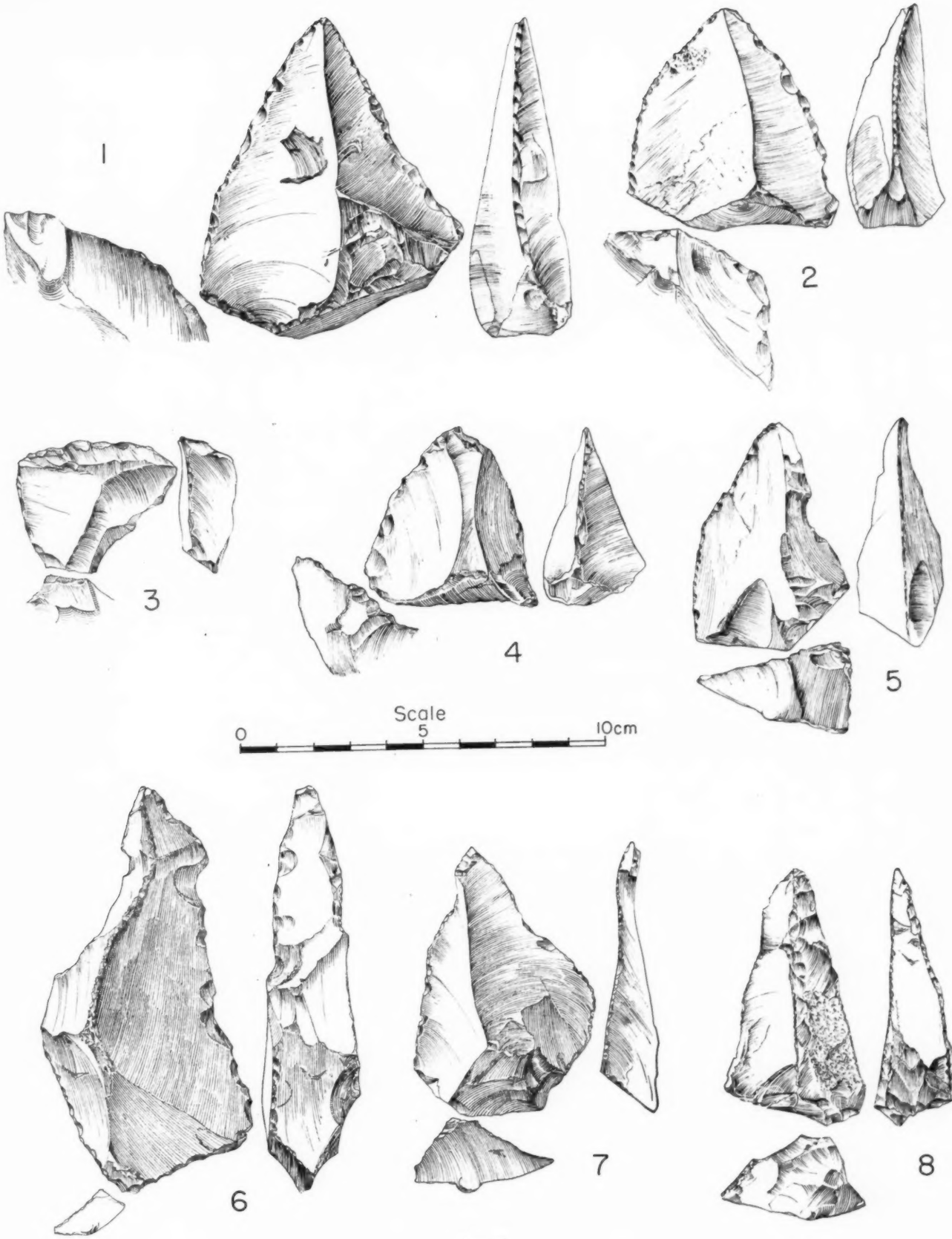


FIG. 29

FIG. 30. Coarse flakes.

1. A coarse flake of grey flint, patinated light brown and unrolled. It is of blade form with a large, triangular striking-platform and a striking angle of 120°. The upper surface is double-ribbed with cortex at the distal end. The left cutting edge shows indentations.

2. A coarse flake of light grey flint, patinated light brown and unrolled. This specimen could also be regarded as a coarse blade. It has a large, somewhat prepared striking-platform. The striking angle is 110°. The upper surface is double-ribbed. Both cutting edges show indentations. A piece has been broken off the distal end from below.

3. A triangular, coarse flake of light grey flint, patinated light brown and unrolled. It is of blade form, and has a large, plain striking-platform, and a striking angle of 120°. The bulb of percussion is very prominent and occupies more than half the length of the specimen which also has a strong middle rib. Both cutting edges show carefully made indentations; especially the right, which is indented predominantly from above.

4. A coarse flake of grey flint, almost unpatinated and unrolled. It is of blade form, and has a large, plain striking-platform, and a striking angle of 115°. The upper surface is single-ribbed. Both cutting edges show over-all indentations; the left ones made from above, the right, from below.

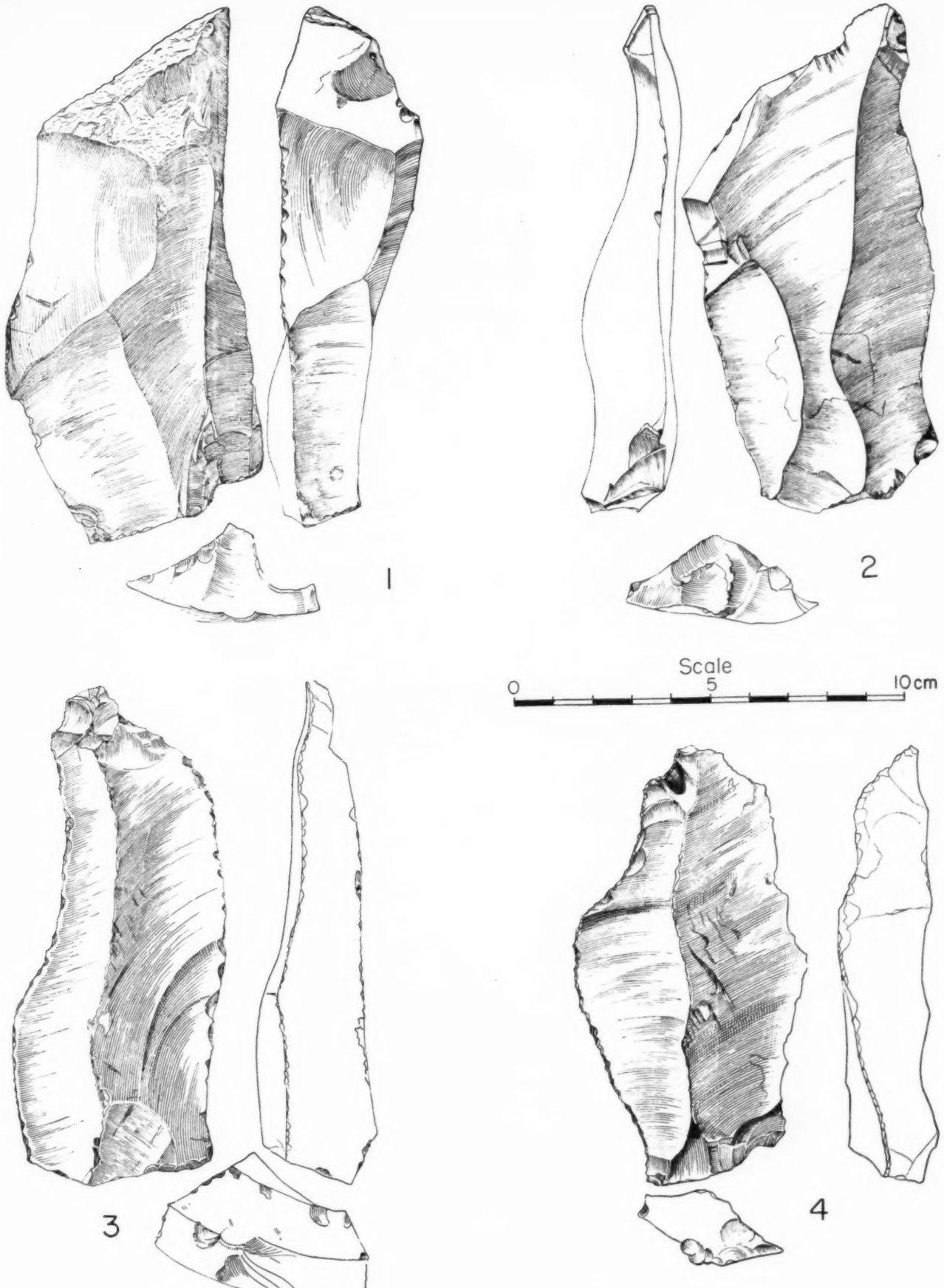


FIG. 30

FIG. 31. Coarse flakes.

1. A pointed, oval, coarse flake of cloudy, light and dark grey flint, patinated brown and unrolled. It has a small striking-platform which lies close to the nodular cortex, a strongly developed cone and bulb, and a striking angle of 110°. The upper surface is primarily single-ribbed, and displays some nodular cortex on the left edge and right rear. The edges exhibit indentations, and also traces of abrasion.

2. A round, oval, thick flake of variegated grey flint, patinated an olive color, and unrolled. It has a plain striking-platform with a strongly projecting percussion cone joined to a thick bulb which occupies the entire lower surface. The striking angle is 110°. The cutting edges are curved on both surfaces corresponding to the curvature of the bulb. The right edge alone has indentations, made mostly from above.

3. A single-ribbed, flat, coarse flake of unrolled, light grey flint. It has a large striking-platform with two prominent cones, and a striking angle of 110°. The upper surface has three flake scars. Both edges exhibit over-all, fine indentations.

4. A broad, oval, thick flake of variegated, dark grey and brown flint, slightly patinated and scarcely rolled. It has a long, broad striking-platform, with multiple points of impact. The two cones combine in a large bulb which occupies the entire lower surface. The left and distal edges were used for cutting purposes and, therefore, show some retouch on both surfaces.

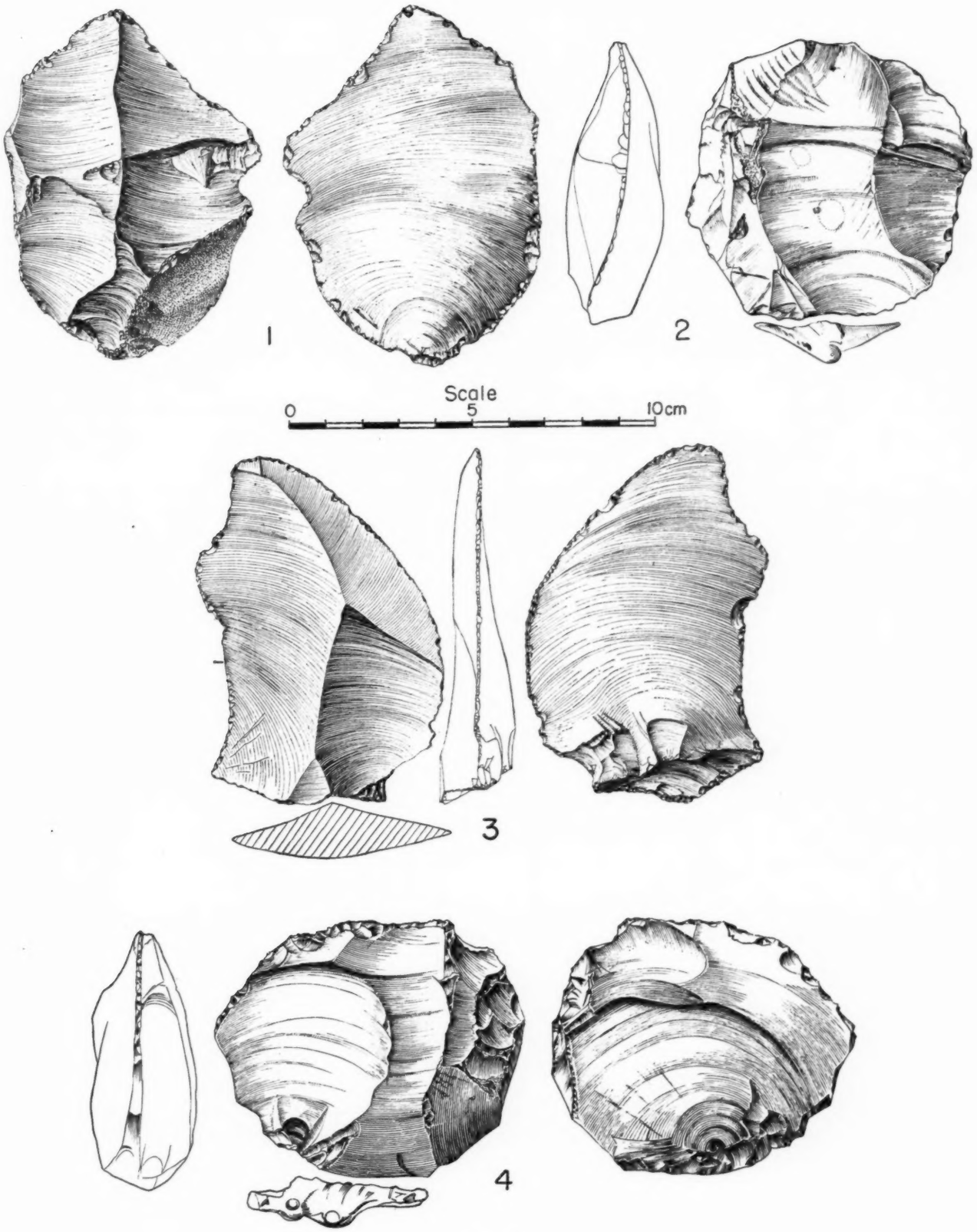


FIG. 31

FIG. 32. Coarse flakes and flake-blades.

1. A broad flake-blade of partly banded or spotty, grey flint, patinated brown and unrolled. It has a large, plain striking-platform, two percussion cones, a thick, prominent bulb, and a striking angle of 125°. The upper surface has a main rib. Both side edges show indentations by means of which a curvature has been worked out on the left.

2. A flake-blade of light grey flint, slightly rolled and patinated brown. It has a large, plain striking-platform, two percussion cones which join in a flat bulb, and a striking angle of 95°. The upper surface has a main rib which forks at the rear as a result of a thinning blow. The left cutting edge shows some indentations; the right one, over-all simple retouching.

3. A single-ribbed, flat flake-blade of cloudy, light and dark grey flint, scarcely patinated and unrolled. It was made by the stone-on-stone technique, and has a large plain striking-platform, a cone and bulb, and a striking angle of 110°. The left cutting edge shows indentations made from both surfaces. The indentations on the right edge have been made primarily from above.

4. A large, almond-shaped flake from a large nodule of cloudy, grey flint, patinated brown and olive, and unrolled. The nodule had been prepared previously by several blows. The striking angle is 110°. The nodular cortex received the heavy stone-on-stone blow which produced a thick, distinct cone joined to a strongly arched bulb which covers the entire lower surface. The cutting edge of the specimen is completely straight and very sharp. The right edge, especially, exhibits fine indentations, made mostly from below.

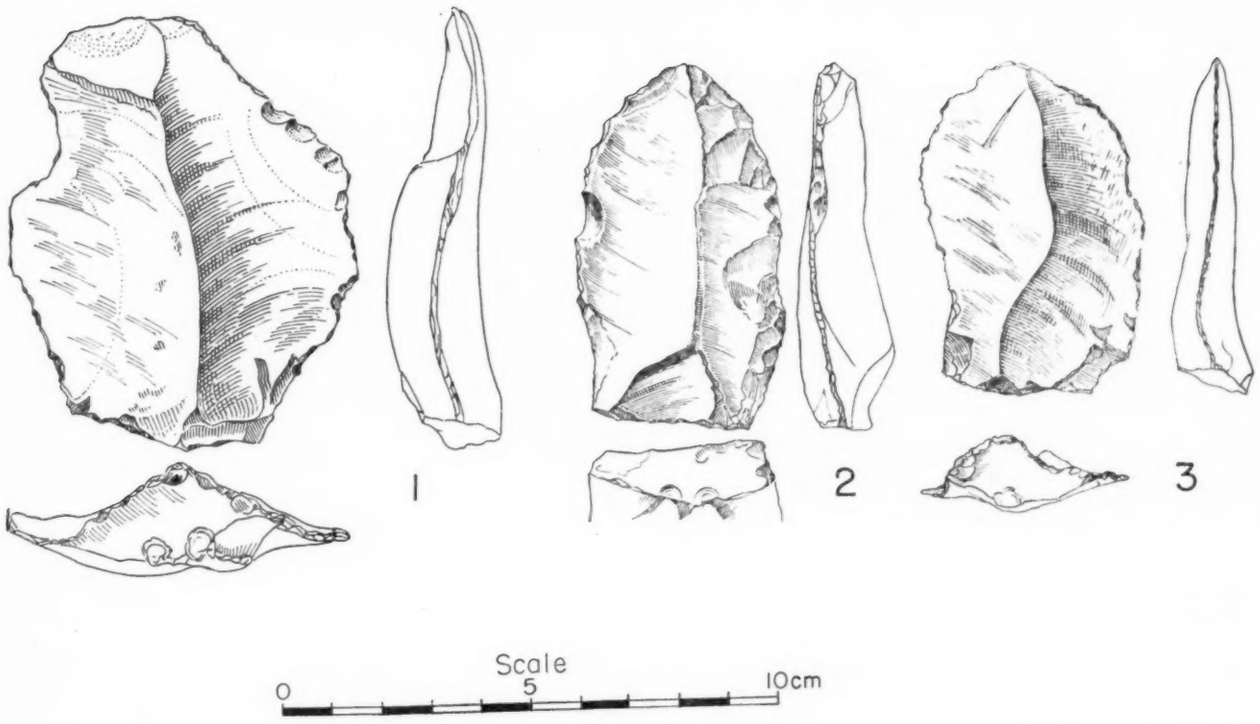


FIG. 32

FIG. 33. Flake-blades.

1. A thick flake-blade of variegated, grey flint, rolled, and patinated a shiny olive-brown. The specimen shows bulbs of percussion on the distal and rear ends; thus, the core was worked from both ends. The percussion bulb at the rear is very prominent. The entire flake is slightly curved. The upper surface has a keel-like main rib, which was removed from one end (to the left in the illustration) by a heavy blow. It may be assumed, therefore, that this is the proximal end of the specimen and that a finger or hafting support was produced here. Both cutting edges (especially the one on the left illustration) show over-all indentations and retouching, mostly on the lower surface.

2. A single-ribbed flake-blade of a cortical piece of dark grey flint, scarcely patinated, and unrolled. It has a plain striking-platform, two percussion cones, and a striking angle of 115°. The left edge shows fine retouching on the lower surface, especially toward the rear. The right edge has been slightly retouched toward the point.

3. Geschwitz. A thick flake-blade of grey flint, patinated brown and slightly rolled. It has a triangular, plain striking-platform, a short percussion cone and bulb, and a striking angle of 115°. The upper surface shows a keel-like main rib. Both cutting edges, the right one of which is curved toward the front, exhibit very simple retouching.

4. Zehmen. A single-ribbed flake-blade of spotty, grey flint, almost unrolled. It was made by the stone-on-stone technique, and has a large, plain striking-platform, and a striking angle of 115°. The upper surface exhibits nodular cortex toward the distal end. A flake has been detached in order to reduce the thickness of the specimen on the rear of the upper surface. Both cutting edges have heavy indentations or traces of rolling.

5. A single-ribbed flake-blade of light grey flint, patinated brown and almost unrolled. It has a large, plain striking-platform, a projecting cone, and a striking angle of 125°. Both cutting edges show heavy indentations or traces of rolling.

6. A thick flake-blade of spotty flint, patinated light brown and unrolled. It was made by the bone billet technique, has a plain striking-platform, and a striking angle of 110°. The lower surface exhibits a slight curvature; the upper surface displays several flake scars and is strongly curved. The cutting edges show hardly any traces of use.

7. A flake-blade of flint, patinated brown and unrolled. It was made by the stone-on-stone technique, and has a triangular, plain striking-platform, and a striking angle of 115°. The distal end consists of a round fracture. Both cutting edges show indentations and traces of abrasion.

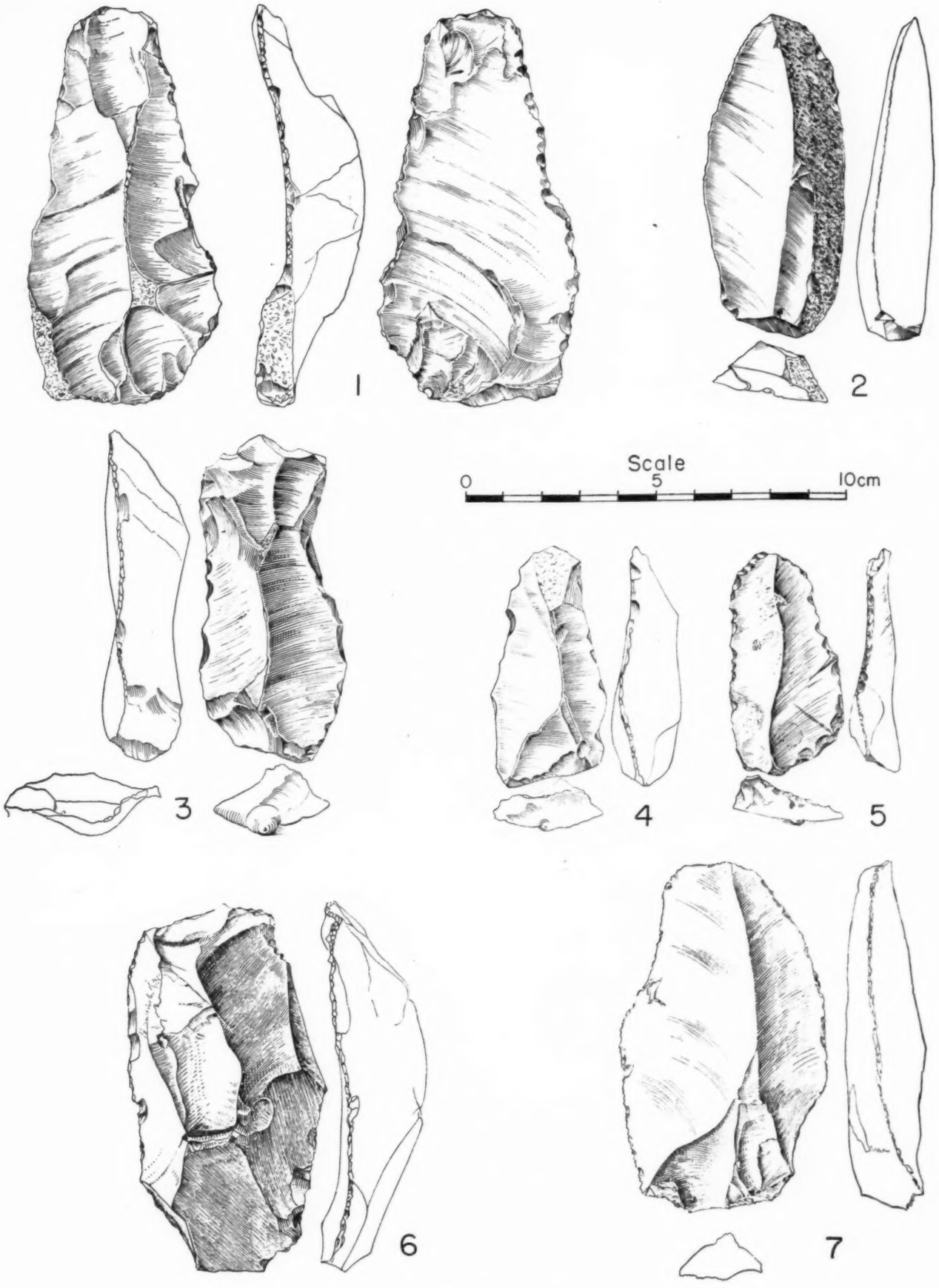


FIG. 33

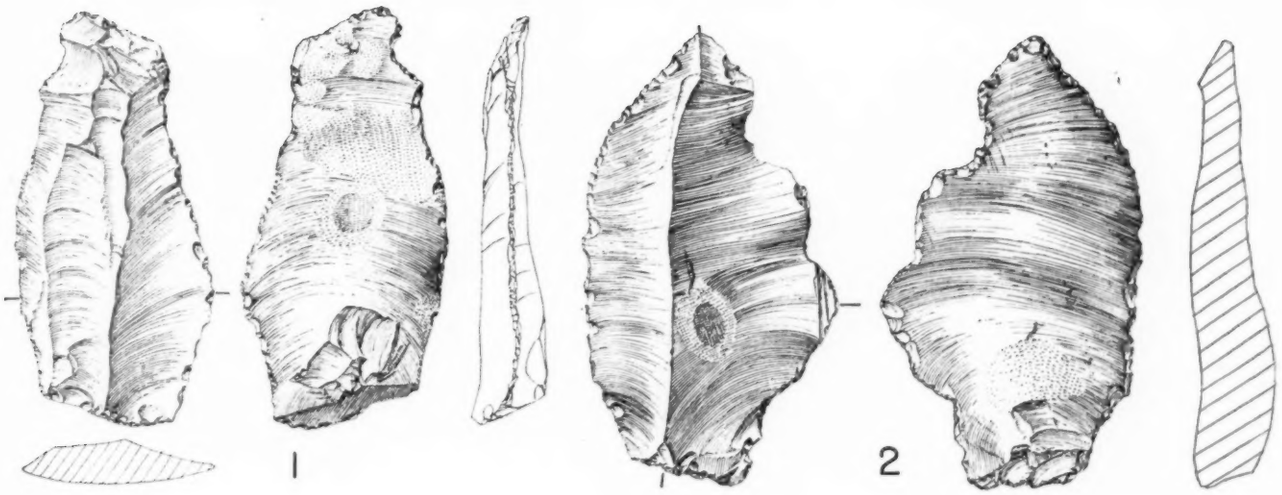
FIG. 34. Blades and flake-blades.

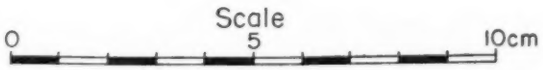
1. A double-ribbed flake-blade of spotty, grey flint, slightly patinated an ochreous color, and unrolled. It has a plain striking-platform, a projecting cone, and a striking angle of 110°. Both cutting edges show indentations. The right one has over-all indentations made from both surfaces; the left, over-all indentations toward the point. The left edge is curved. The longitudinal axis of the specimen is not at a right angle to the striking-platform.

2. A single-ribbed, coarse blade of spotty, grey flint, slightly patinated brown and rolled. The striking-platform shows a few facets. The striking angle is 115°. Both cutting edges show over-all indentations, made primarily from below. The indentations on the right edge form concavities which were used.

3. A broad, single-ribbed, large blade of grey flint, slightly patinated and unrolled. It has a large faceted striking-platform at a right angle to the long axis, and indentations on both cutting edges. There are also indentations on the distal edge, mostly on the upper surface.

4. A large flake of grey flint, slightly patinated and unrolled. It has a carefully trimmed striking-platform at a right angle to the long axis. The upper surface has several flake scars. The right cutting edge shows some indentations made from below. The left distal corner has been broken off in antiquity, probably as the result of use.





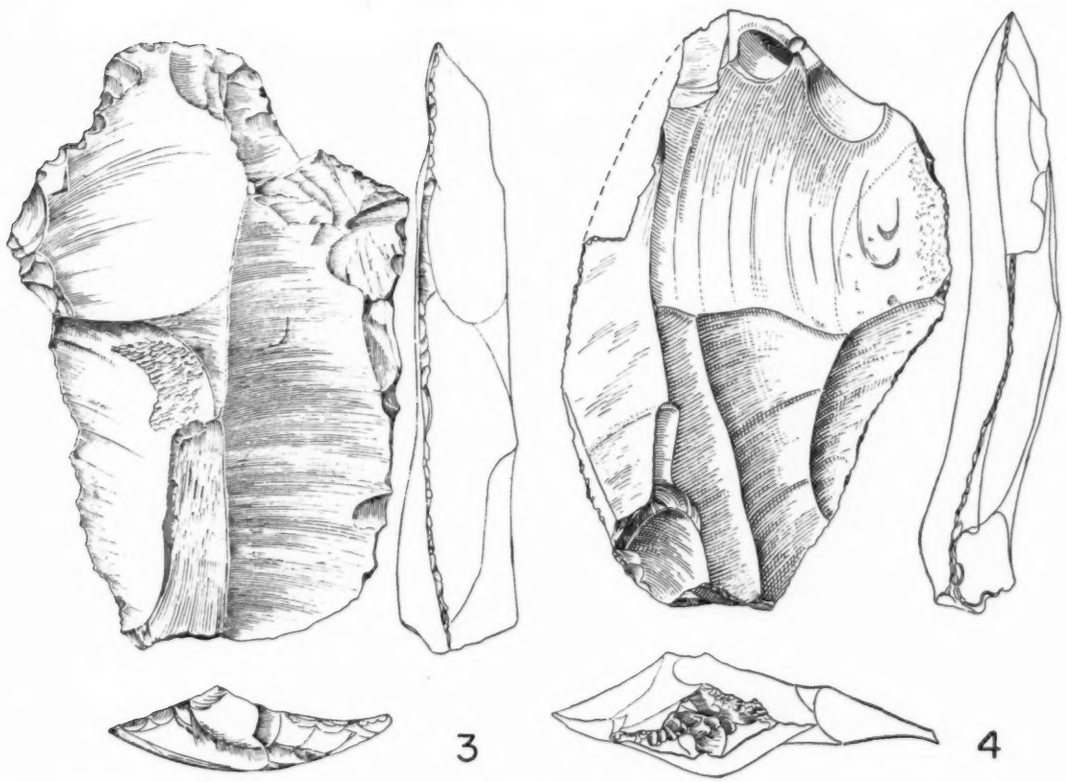


FIG. 34

FIG. 35. Blades and flake-blades.

1. A large flake-blade of unrolled, brown-patinated flint. It has a small, faceted striking-platform at a right angle to the long axis, and ends in a round fracture. The upper surface is marked by two long flake scars. The right cutting edge exhibits over-all indentations made from above; the left, over-all indentations made from below.

2. A large flake-blade of grey flint, with a rusty patina and unrolled. It has a small striking-platform which is slightly trimmed and lies at a right angle to the long axis. The distal end consists of a round fracture. The upper surface retains some nodular cortex, and is primarily single-ribbed. Both cutting edges show only a few indentations.

3. A large blade of bryozoa-carrying, grey flint, lightly patinated brown, and unrolled. It has a small, slightly prepared striking-platform at a right angle to the long axis, and many flake scars on the upper surface. Both cutting edges exhibit some indentations.

4. A large, double-ribbed, narrow blade of light grey flint, patinated dark brown, and unrolled. It has a small striking-platform at a right angle to the long axis, and a slight curvature. The left edge exhibits over-all indentations made from both surfaces; the right, over-all indentations made primarily from below. The distal end of the specimen has been broken off recently.

5. A large, single-ribbed, narrow blade of light grey flint, with a slightly rusty patina, and unrolled. It was made by the bone billet technique, and has a plain striking-platform, and a striking angle of 110°. The edges exhibit few indentations.

6. A single-ribbed, flake-blade of clouded, grey flint, patinated light brown and unrolled. It has a faceted striking-platform, and a rectangular point of percussion. The right edge is steep at the distal end, and was unused. The left cutting edge shows over-all indentations along the lower surface.

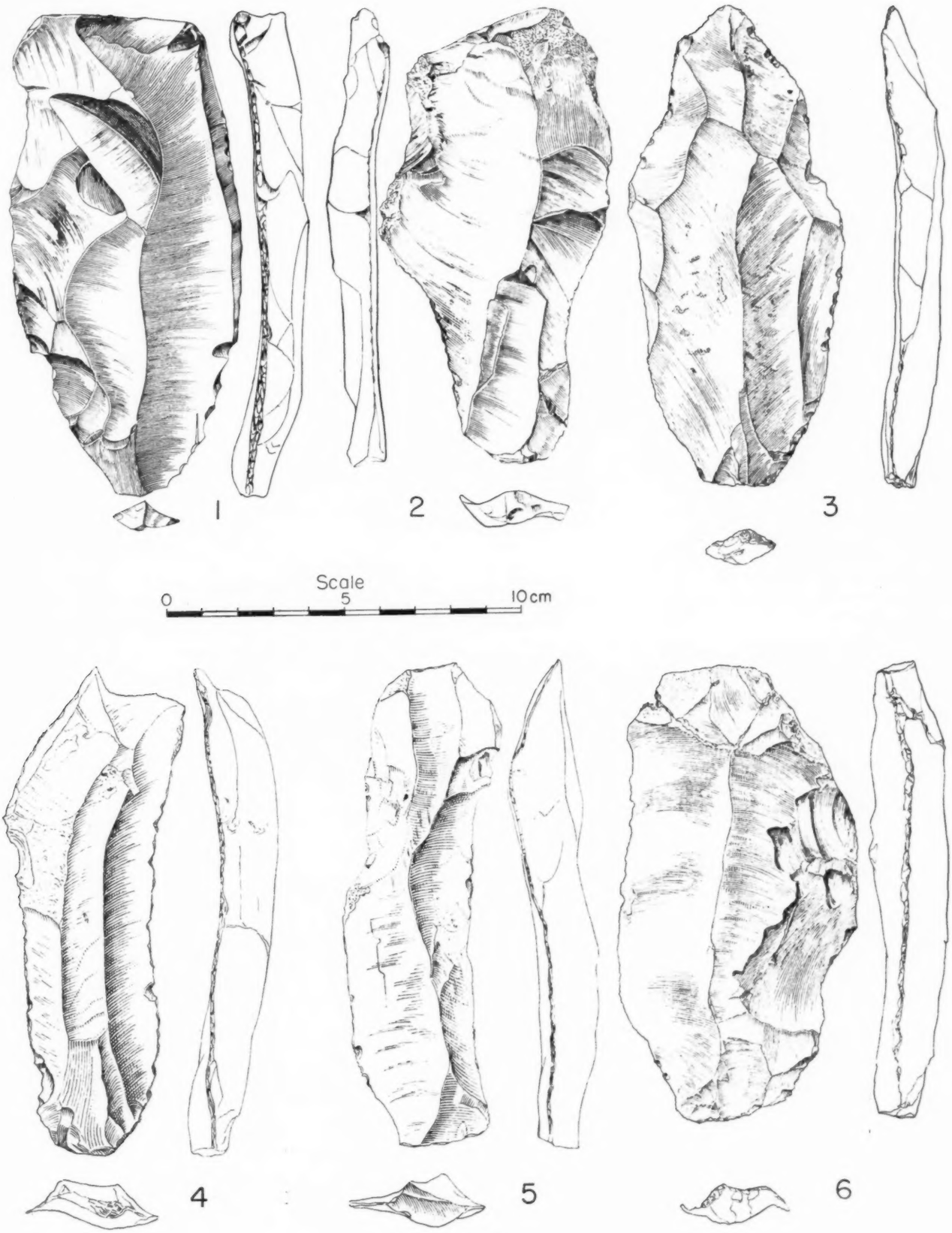


FIG. 35

FIG. 36. Blades.

1. A large, double-ribbed, narrow blade of grey flint, with a yellowish patina and almost unrolled. It has a plain striking-platform, which is at a right angle to the long axis. The cutting edges exhibit over-all indentations; the left, made from above; the right, from below.

2. A large, single-ribbed, narrow blade of light grey flint, patinated ochreous yellow, and unrolled. It has a large, plain striking-platform, a slight curvature, and a striking angle of 110°. Both edges are steep and blunt at the distal end. Toward the rear they show over-all indentations, made mostly from above.

3. A large, double-ribbed, narrow blade of light grey flint, patinated brown, and unrolled. It has a small, faceted striking-platform at a right angle to the long axis, a long, narrow bulb, and a slight curvature. Both cutting edges exhibit over-all indentations. The forking of the point seems to be intentional.

4. A large blade of cloudy, grey flint, unrolled and almost unpatinated. It was made by the stone-on-stone technique, and has a large, faceted striking-platform, and a thick bulb which has been thinned by a second blow. The blade has a slight curvature and exhibits several flake scars on the upper surface. The left cutting edge shows indentations made from below.

5. A large, narrow blade of spotty, grey flint, with a yellowish patina, and unrolled. It has a faceted striking-platform at a right angle to the long axis, and a slight curvature. The cutting edges are sharp with almost no indentations. The distal end consists of a round fracture.

6. A large, narrow blade of cloudy, grey flint, patinated olive-brown, and unrolled. It has a small, faceted striking-platform at a right angle to the long axis, and a slight curvature. The left cutting edge shows over-all indentations made from below. The right edge exhibits over-all indentations made from both surfaces. This blade has been previously illustrated by Grahmann (1935).

7. A large, single-ribbed, narrow blade of grey flint, with a rusty patina, and unrolled. It has a small, narrow, faceted striking-platform which is broken off on the left side in the rear. The bulb of percussion has also been removed. The blade has a slight curvature and over-all, coarse indentations along both edges.

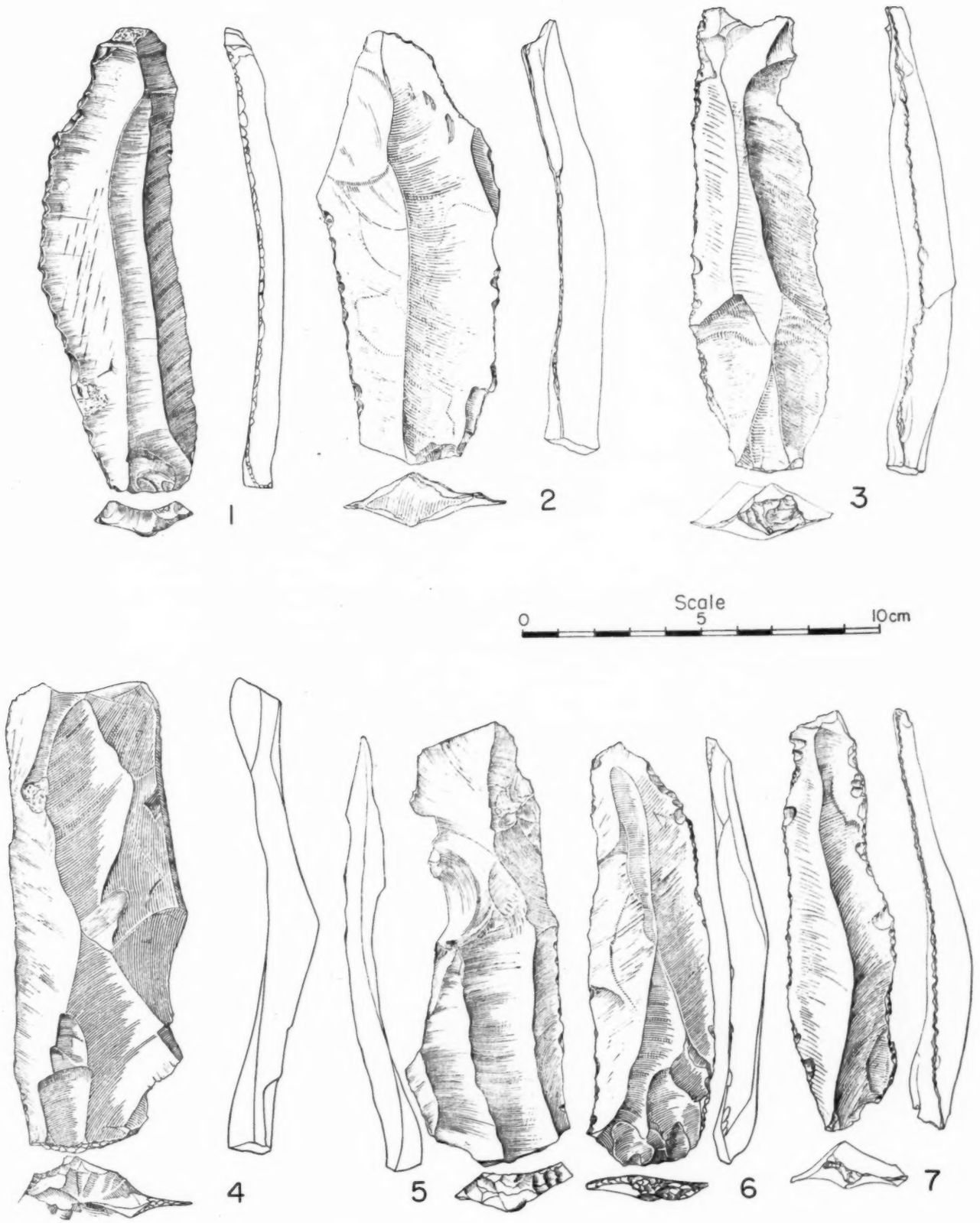


FIG. 36

FIG. 37. Blades.

1. A large, double-ribbed, narrow blade of cloudy, grey flint, patinated a light olive color, and unrolled. It has a small, narrow striking-platform and a slight curvature. Possibly it was detached by using an intermediary tool. Both cutting edges show light indentations, mainly on the lower surface.

2. A large, single-ribbed, flat, narrow blade of grey flint, with a brownish patina, and almost unrolled. It has a small, faceted striking-platform at a right angle to the long axis, and a slight curvature. Both cutting edges show over-all indentations, mostly on the lower surface.

3. A double-ribbed, narrow blade of light grey flint, with a slightly rusty patina, and unrolled. It was made by the stone-on-stone technique, and has a large, plain striking-platform, a cone, and a striking angle of 110°. Both cutting edges exhibit fine indentations, mostly on the lower surface.

4. A large, single-ribbed, narrow blade of grey flint, scarcely patinated, and unrolled. It has a faceted striking-platform and a striking angle of 95°. The noticeably parallel cutting edges show a few fine indentations. The point of the specimen was broken off in antiquity.

5. A thick blade of banded, grey flint, with a brownish patina, and unrolled. It was made by the stone-on-stone technique, and has a small, plain striking-platform, and a striking angle of 110°. Both cutting edges exhibit indentations made from both surfaces.

6. A thick, double-ribbed, narrow blade of light grey flint, with a slightly brownish patina, and unrolled. It has a small, faceted striking-platform, and a striking angle of 105°. The right edge is rather steep and without indentations. The left edge shows only very few indentations.

7. A blade of grey flint, slightly rolled and heavily patinated light brown. It was made by the bone billet technique, and has a small, faceted striking-platform, and a striking angle of 90°. The upper surface is primarily double-ribbed. Both cutting edges show over-all indentations on the lower surface, and a few more recent traces of rolling. The left cutting edge in the rear has a recently produced projection. This blade has been illustrated by Grahmann (1935).

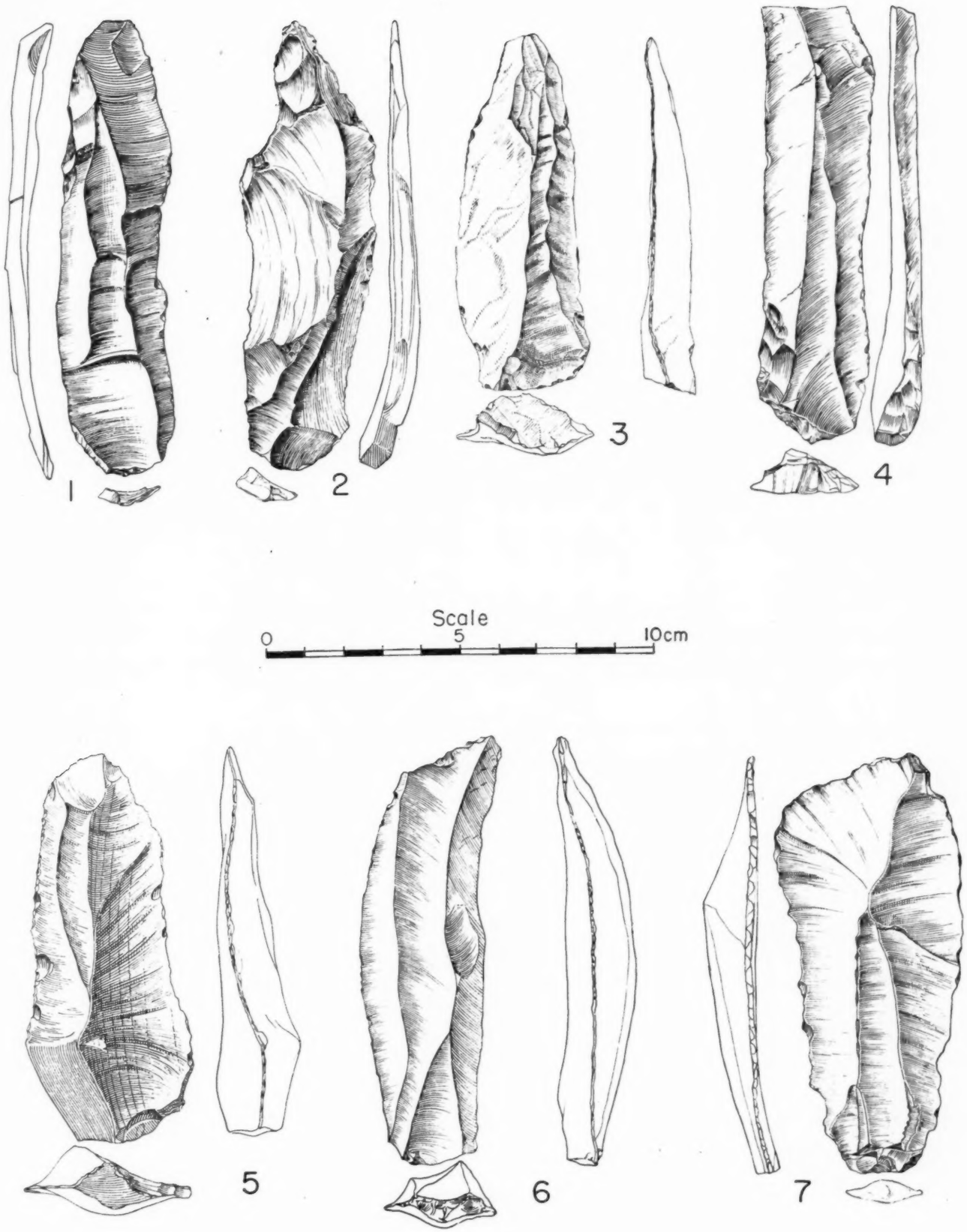


FIG. 37

FIG. 38. Blades.

1. A single-ribbed, flat blade of bryozoa-carrying, grey flint, slightly patinated, and unrolled. It has a plain striking-platform, a slight curvature, and a striking angle of 100°. Both cutting edges show over-all indentations along the lower surface.

2. A narrow blade of grey flint, partially covered with a rusty patina, and unrolled. It has a small, plain striking-platform, a slight curvature, and a striking angle of 100°. The upper surface is mainly single-ribbed. Neither cutting edge shows any indentations.

3. A narrow blade of grey flint, patinated an olive color, and unrolled. It has a small, faceted striking-platform at a right angle to the long axis, and a slight curvature. The upper surface is mainly single-ribbed. The left edge is steep and blunt at the distal end but becomes sharp toward the rear, with over-all indentations made from below. The right distal edge exhibits some nodular cortex and some very fine indentations toward the rear.

4. A flat, narrow blade of light grey flint, patinated light brown, and unrolled. It has a long, narrow, plain striking-platform and a striking angle of 95°. The upper surface exhibits a main rib and a few secondary flake scars. The cutting edges show a few indentations.

5. A flat blade of unrolled, translucent, olive-colored flint. It has a narrow, faceted striking-platform at a right angle to the long axis, and a slight curvature. The upper surface is, on the whole, double-ribbed. Both edges exhibit over-all indentations, mostly on the lower surface.

6. A blade of grey flint, patinated an olive color with a white patina beginning along the edges. It has been rolled, and has a faceted striking-platform at a right angle to the long axis. The upper surface is, on the whole, single-ribbed. The right edge shows over-all indentations made from below. In addition, the entire specimen exhibits rather pronounced traces of rolling.

7. A narrow blade of grey flint, with a yellowish patina, and unrolled. It was made by the bone billet technique, and has a small striking-platform, and a slight curvature. The upper surface is, on the whole, double-ribbed with a flake scar toward the rear making the blade usable for hafting. The right cutting edge has a saw-tooth finish, made by flaking from above and below. The left cutting edge exhibits very fine indentations on the lower surface.

8. A double-ribbed blade of grey flint, with a light patina, and rolled. It has a small, faceted striking-platform, and a striking angle of 100°. Both cutting edges show coarse indentations. The distal end of the blade was broken off in antiquity.

9. Zehmen. A blade of light grey, bryozoa-carrying flint, rolled and heavily patinated. The upper surface exhibits a whitish patina which places the specimen close to Preservation Group 1. It has a small, plain striking-platform, a slight curvature, and a striking angle of 110°. The upper surface has a single rib. Both cutting edges exhibit coarse indentations and traces of rolling.

10. A flat, single-ribbed, narrow blade of translucent, olive-colored flint, scarcely patinated, and unrolled. It has a very small, faceted striking-platform and a slight curvature. There is nodular cortex on the distal end. Both cutting edges show over-all indentations, made mostly from the lower surface.

11. Zehmen. A narrow blade of grey flint, patinated an olive color, and rolled. It was made by the bone billet technique, and has a faceted striking-platform, and a striking angle of 105°. The strong curvature ends at the distal extremity in a round fracture. The upper surface has a single rib in front, which forks toward the rear. Both cutting edges show coarse indentations and traces of rolling.

12. A narrow blade of translucent, grey flint, slightly patinated and unrolled. It has a very small, plain striking-platform, a slight curvature, and a short bulb. The upper surface shows a rib which forks toward the rear. Here, as in the case of *pointes triangulaires*, the flake scar causing the fork makes the blade suitable for hafting. Both cutting edges, especially the right one, have a saw-tooth finish produced by flaking alternatively from above and below. The point of the specimen is missing.

13. A flake-blade of grey flint, slightly patinated, and almost unrolled. It has a small, faceted striking-platform which lies at a right angle to the long axis. The upper surface shows several flake scars similar to a Levalloisian flake. The right edge exhibits over-all indentations, made mostly from above.

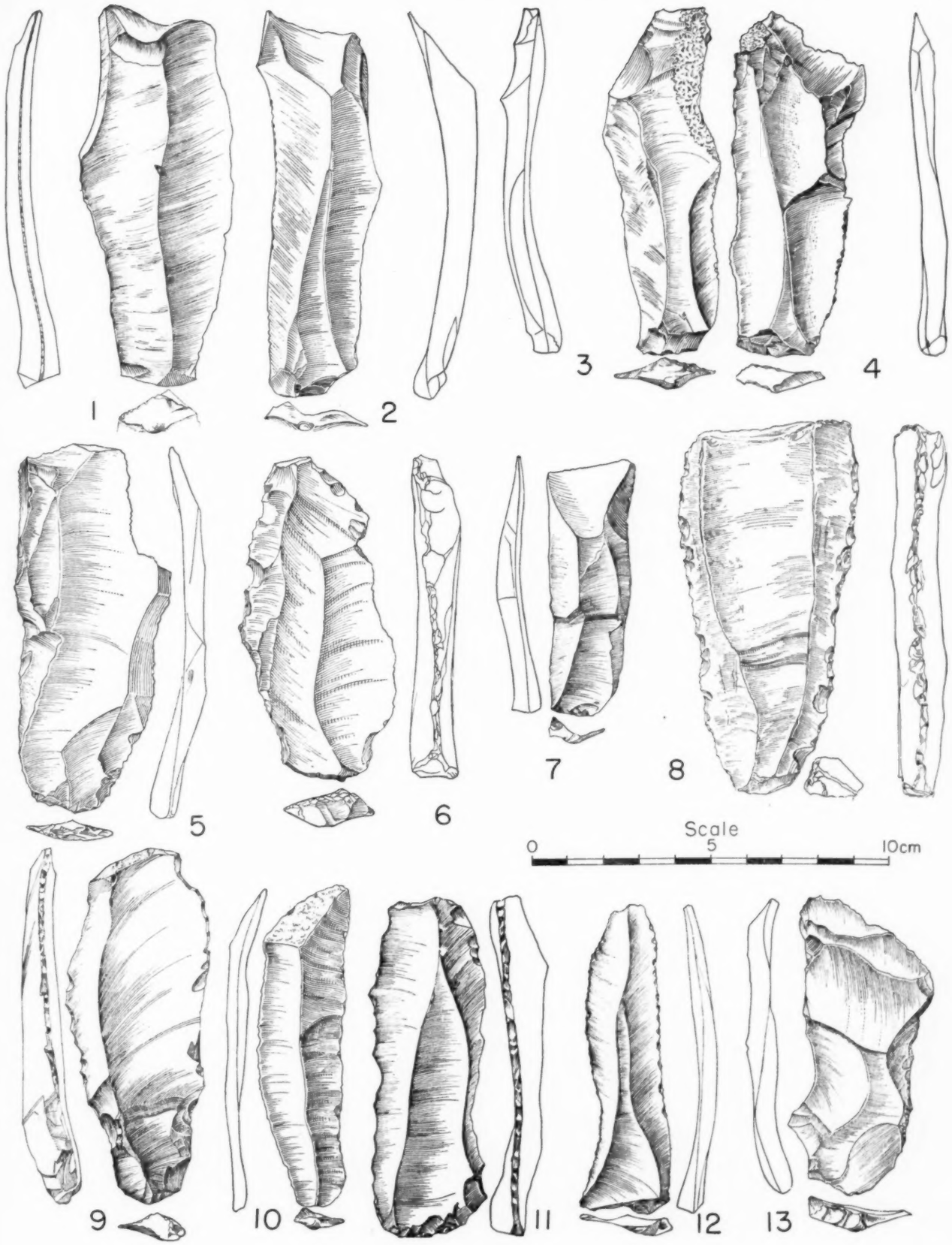


FIG. 38

FIG. 39. Blades.

1. A blade of light grey flint, patinated ochreous yellow, and unrolled. It has a large, faceted striking-platform at a right angle to the long axis, and a slight *S*-curvature of the lower surface. The left and distal edges are steep and blunt with some cortex. The right cutting edge shows over-all indentations, mostly on the lower surface. The point on the right distal extremity was probably originally accidental, but appears to have been sharpened by a few small blows.

2. A single-ribbed blade of light grey flint, with a light ochreous patina, and unrolled. It has a small, plain striking-platform and a striking angle of 105°. Both cutting edges are almost without indentations.

3. A double-ribbed blade of light grey flint, slightly patinated, and unrolled. It was made by the bone billet technique, and has a faceted striking-platform, a short, prominent bulb, a slight curvature, and a striking angle of 110.° The left cutting edge exhibits over-all indentations which become fine toward the distal end, and which are mostly on the lower surface. The right cutting edge shows over-all indentations or coarse retouching toward the rear on the lower surface, and fine retouching at the distal end on the upper surface. This blade has been previously illustrated by Grahmann (1935).

4. A flat, broad blade of light grey flint, slightly patinated, and almost unrolled. It has a narrow, faceted striking-platform which lies at a right angle to the long axis. The upper surface shows several flake scars. The left cutting edge exhibits indentations made from above; the right, indentations made mainly from below.

5. A blade of translucent, grey flint, with a rusty patina, and unrolled. It has an extended, plain striking-platform, which lies at a right angle to the long axis. The upper surface is, on the whole, double-ribbed. The left and distal cutting edges exhibit over-all indentations made from below. The right cutting edge has over-all indentations made from above.

6. A flat, broad blade of unrolled, translucent, dark grey flint. It has an extremely narrow striking-platform which lies at a right angle to the long axis. The upper surface shows several flake scars. The left edge was unused. The right edge exhibits a few indentations made from both surfaces.

7. A single-ribbed blade of fresh-water quartzite from the Lower Tertiary. It is almost unrolled and has a slightly faceted striking-platform and a striking angle of 110°. But cutting edges show indistinct indentations.

8. A single-ribbed blade of grey flint, with a brownish patina, and unrolled. It was made by the bone billet technique, and has a large, faceted striking-platform, a short, prominent bulb, and a striking angle of 110°. The left edge was unused. The right cutting edge shows indentations and traces of abrasion.

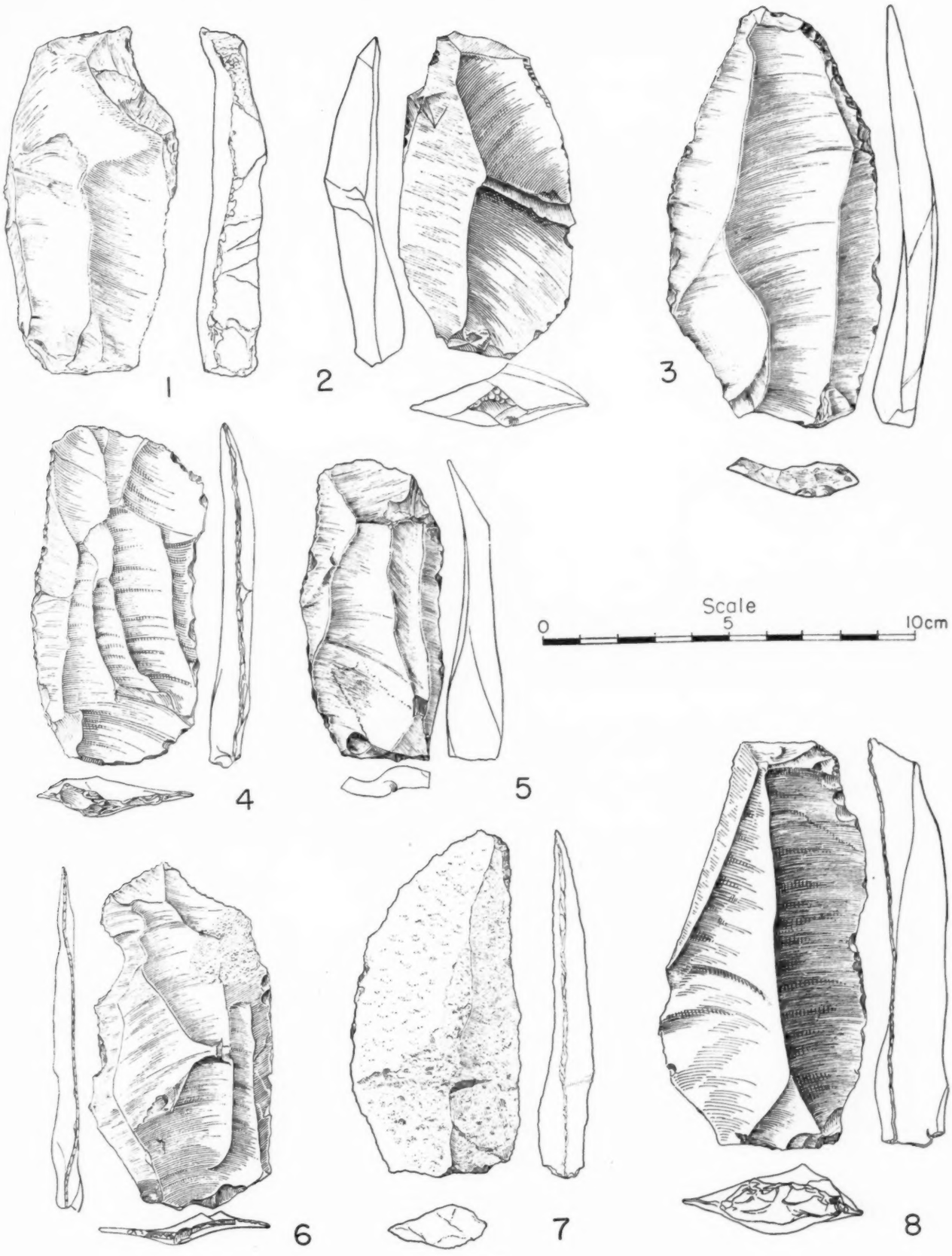


FIG. 39

FIG. 40. Blades.

1. A double-ribbed, broad blade of grey flint, partly covered with a rusty patina, and unrolled. It was made by the stone-on-stone technique, and has a plain striking-platform, and a slight curvature. The cutting edges show scarcely any indentations.

2. A broad blade of dark grey flint, almost without patina, and unrolled. It has a plain striking-platform, a striking angle of 100°, and a slight curvature. The upper surface has several flake scars and exhibits cortex at the distal end. The left cutting edge displays over-all indentations made from below. The right edge shows only a few indentations.

3. A broad blade of light grey flint, with a yellowish patina, and unrolled. It has a plain striking-platform, a prominent bulb, a striking angle of 100°, and several flake scars on the upper surface. Both cutting edges show irregular indentations made from both surfaces.

4. A double-ribbed, broad blade of translucent, light grey flint, slightly patinated, and unrolled. It has a narrow, faceted striking-platform, which lies at a right angle to the long axis. The cutting edges show no indentations.

5. A poorly made broad blade of grey flint, slightly patinated, and unrolled. It has a large, extended, faceted striking-platform and a striking angle of 105°, The upper surface exhibits a single rib which forks toward the rear. Both edges show some indentations.

6. A broad blade of light grey flint, with an ochreous-brown patina, and unrolled. It has a plain striking-platform, which lies at a right angle to the long axis. The upper surface exhibits a single rib which forks toward the rear. The side and distal cutting edges show over-all indentations made from above.

7. A broad blade of light grey flint, slightly patinated, and unrolled. It was made by the stone-on-stone technique, and has a long, extended, faceted striking-platform, which lies at a right angle to the long axis. The upper surface exhibits several flake scars. Both cutting edges show indentations made from above.

8. A broad blade of grey flint, with a slightly rusty patina, and unrolled. It has a small striking-platform at a right angle to the long axis, and a slight curvature. The upper surface shows a single rib which forks toward the rear. The right cutting edge exhibits some indentations made from below; the left shows none.

9. A broad blade of light grey flint, partly with a rusty patina, and unrolled. It has a very small, plain striking-platform and a striking angle of 100°. The upper surface exhibits many flake scars. The left cutting edge shows over-all indentations made from below. This blade has been previously illustrated by Grahmann (1935).

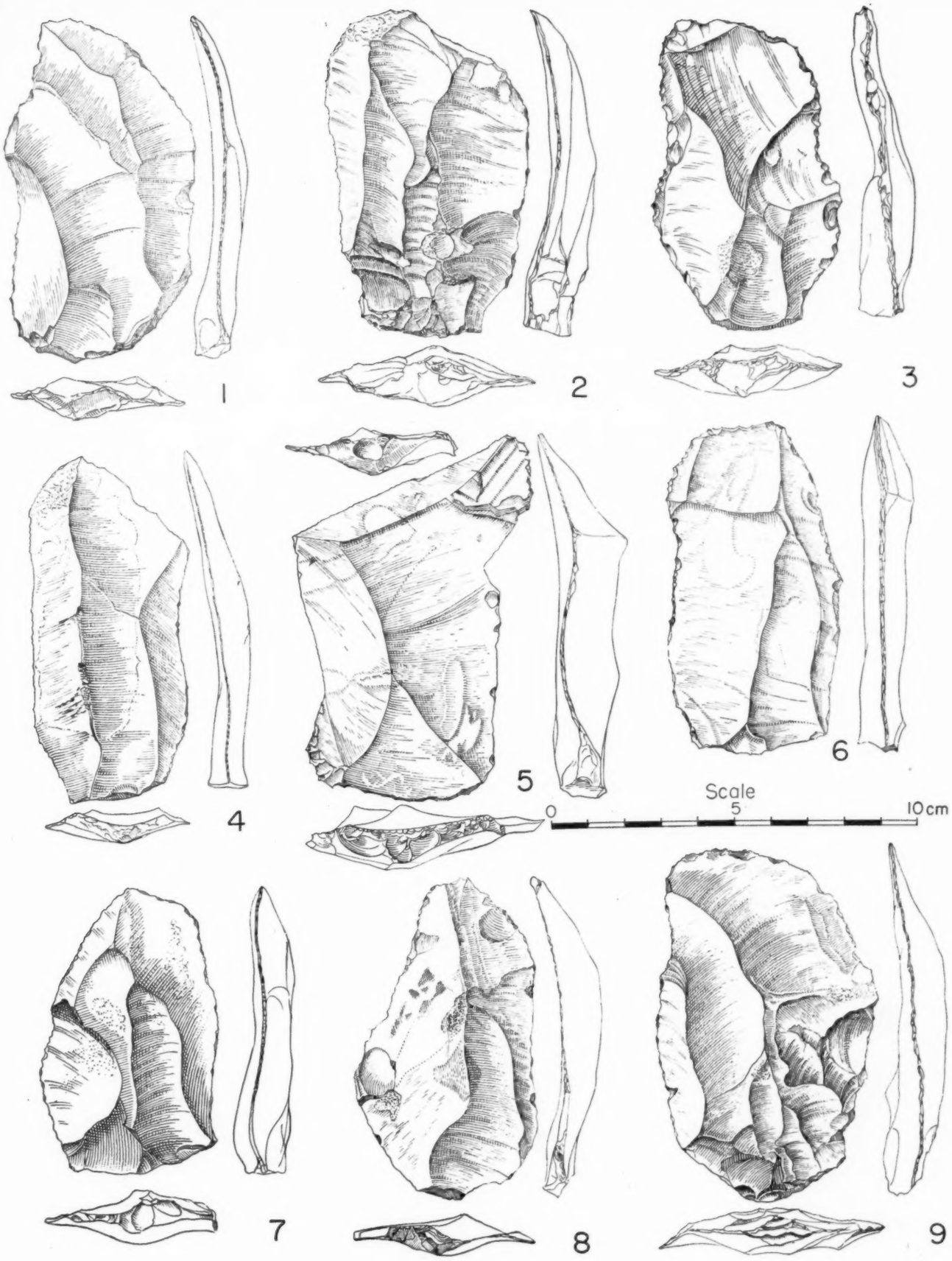


FIG. 40

FIG. 41. Blades.

1. A flake-blade of banded, grey flint, rolled, with a shiny light brown patina. It has a small, plain striking-platform, was made by the bone billet technique, and has a striking angle of 100°. The upper surface exhibits several flake scars similar to a tortoise core. The cutting edges, therefore, do not run parallel. They exhibit coarse, over-all indentations and traces of more recent rolling. The specimen has been described previously by Jacob-Friesen (1914).

2. An oval flake-blade of light grey flint, patinated ochreous yellow, and unrolled. It has a plain striking-platform, was made by the bone billet technique, has a slight curvature, and a striking angle of 100°. The upper surface exhibits flake scars and heavy stepped flaking at the rear. The left edge shows indentations made from below; the right, indentations made from both above and below. The specimen is intermediate in form between flake-blades and points.

3. A flake-blade of spotty grey flint, slightly patinated, and unrolled. It has a small striking-platform, a striking angle of 90°, and was made by the bone billet technique. The upper surface shows several flake scars and some nodular cortex on the right distal end. Both cutting edges exhibit very fine indentations.

4. A flake-blade of translucent, grey flint, with a brownish patina, and unrolled. It has a very small, narrow striking-platform, was made by the bone billet technique, and has a striking angle of 90°. The upper surface exhibits several flake scars and is thinned at the rear. Both cutting edges show very fine indentations made from above and below.

5. A blade of unrolled, partly rusty, light grey flint. It has a small, narrow, plain striking-platform, was made by the bone billet technique, and has a striking angle of 100°. The upper surface is double-ribbed. Both cutting edges show very fine indentations made from both above and below.

6. A blade of light grey flint, slightly patinated, and unrolled. It has a narrow, plain striking-platform, was made by the stone-on-stone technique, and has a striking angle of 110°. The upper surface is primarily single-ribbed. Both side and distal cutting edges exhibit indentations.

7. Zehmen. A blade of grey flint, with a brownish patina, and slightly rolled. It has a small, plain striking-platform, was made by the stone-on-stone technique, has a prominent bulb, and a striking angle of 90°. The upper surface shows two to three ribs. The right edge is steep and blunt; the left cutting edge, irregularly retouched from both above and below, forms a cleanly retouched curvature toward the distal end, where it shows over-all indentations made from below.

8. A flat, broad blade of spotty, honey-yellow colored, translucent flint, unrolled. The patina is extremely slight. Here and there, however, spots of white patina are beginning. It has a faceted striking-platform at a right angle to the long axis, and was made by the bone billet technique. It exhibits a flat upper surface with two ribs. The right edge is blunt and the left cutting edge shows saw-tooth indentations.

9. A flake-blade of light grey flint, with a yellowish patina, and unrolled. It was made by the stone-on-stone technique, has a small striking-platform, and a striking angle of 90°. The upper surface exhibits several flake scars. The cutting edges show very fine indentations.

10. A flake-blade of light grey flint, slightly patinated, and unrolled. It has a large, plain striking-platform, was made by the stone-on-stone technique, and has a striking angle of 105°. The upper surface exhibits several flake scars. The right edge shows many indentations. The specimen is intermediate in form between flake-blades and blade points.

11. A large blade of grey flint, patinated light brown, and unrolled. It has a plain striking-platform, and was probably made by the bone billet technique. The bulb is broken off. The upper surface exhibits one rib which forks toward the distal end and which has been removed in the rear by a thinning blow. Both cutting edges show very fine over-all indentations, chiefly on the lower surface. The point on the left distal end was broken off in antiquity.

12. A single-ribbed, broad blade with a side point, of cloudy, dark grey- and olive-colored flint, almost without patina, and unrolled. It was made by the stone-on-stone technique, and has a faceted striking-platform, which lies at a right angle to the long axis. The left cutting edge shows a few indentations made from above; the right one, over-all indentations made from below.

13. A flake-blade of grey flint, patinated an olive color, and unrolled. It has a plain striking-platform, a cone and a prominent bulb with a projection, and a striking angle of 95°. The upper surface exhibits several flake scars and some nodular cortex at the distal end. Both side and distal cutting edges show indentations.

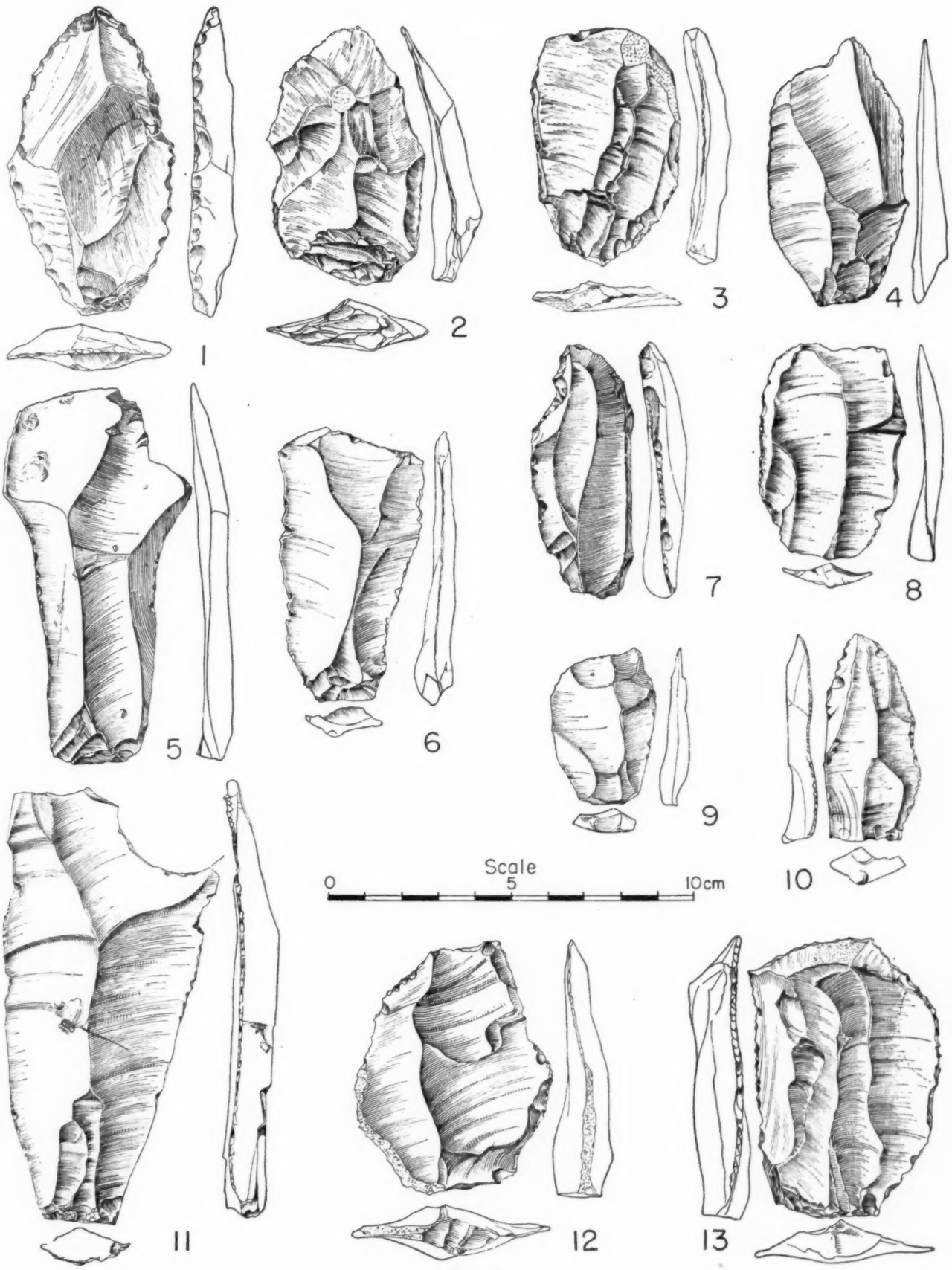


FIG. 41

FIG. 42. Blades.

1. A narrow, single-ribbed blade of light grey flint, unrolled, with a slightly brownish patina. It has a small, plain striking-platform, was made by the bone billet technique, and has a striking angle of 105°. The distal end consists of a round fracture. Both cutting edges show over-all indentations made from above.

2. A double-ribbed, narrow blade of light grey flint, unrolled, with a light yellow-ochreous patina. It has a large, plain striking-platform, which lies at a right angle to the long axis. The cutting edges show no indentations.

3. A flat, single-ribbed, narrow blade of translucent, olive-colored flint, unrolled, and scarcely patinated. It has a long, narrow, faceted striking-platform and a slight curvature. Both cutting edges show fine indentations on the lower surface.

4. A double-ribbed, flat blade of grey flint, unrolled, with a light brown patina. It has a small, plain striking-platform, a striking angle of 110°, and a slight curvature. The cutting edges show no indentations.

5. A flat, rather narrow blade of grey flint, unrolled, with a brownish patina. It has a very narrow striking-platform, probably the result of an intermediary tool, and a slight curvature. The distal end was broken off in antiquity. The upper surface exhibits several flake scars and one main rib. Both cutting edges show very fine indentations on the lower surface.

6. A single-ribbed, flat, narrow blade of grey flint, unrolled, with a yellowish patina. It has a very small striking-platform, probably the result of an intermediary tool, and a slight curvature. The left portion of the distal end was broken off in antiquity. Both cutting edges show very fine over-all indentations.

7. A double-ribbed, flat, narrow blade of spotty, dark grey flint, unrolled. It has a narrow, faceted striking-platform at a right angle to the long axis, and a slight curvature. The distal end of the blade has been recently broken off. Both cutting edges show some indentations made from both above and below.

8. A blade of dark grey flint, slightly patinated and unrolled. It has a large, carefully faceted striking-platform, which lies at a right angle to the long axis. On the distal end is an area of nodular cortex. The upper surface exhibits several flake scars. The left cutting edge shows single indentations made from above; the right is retouched somewhat toward the distal end and has a small prepared curvature.

9. A flat, single-ribbed, narrow blade of translucent, olive-colored flint, scarcely patinated, and unrolled. It has a narrow, faceted striking-platform, a slight curvature, and a few indentations along both cutting edges.

10. A double-ribbed blade of grey flint, unrolled and only slightly patinated. It has a small, plain striking-platform, was made by the stone-on-stone technique, has a striking angle of 100°, a cone, and a very small, flat bulb of percussion. The cutting edges show over-all indentations made from above on the left and from below on the right.

11. A flat blade tapering toward the distal end of spotty, grey flint, unrolled, with a slightly rusty patina. The striking-platform was removed by a thinning blow aimed at the bulb of percussion. The upper surface exhibits a few flake scars while both cutting edges show over-all indentations made mostly from above.

12. A flat, broad blade of translucent, grey, partly banded flint with a slight patina, and unrolled. The long, narrow striking-platform is faceted. The upper surface exhibits a few flake scars. The distal end of the blade was broken off in antiquity. The cutting edges show only a few indentations. This is a typical Levalloisian blade.

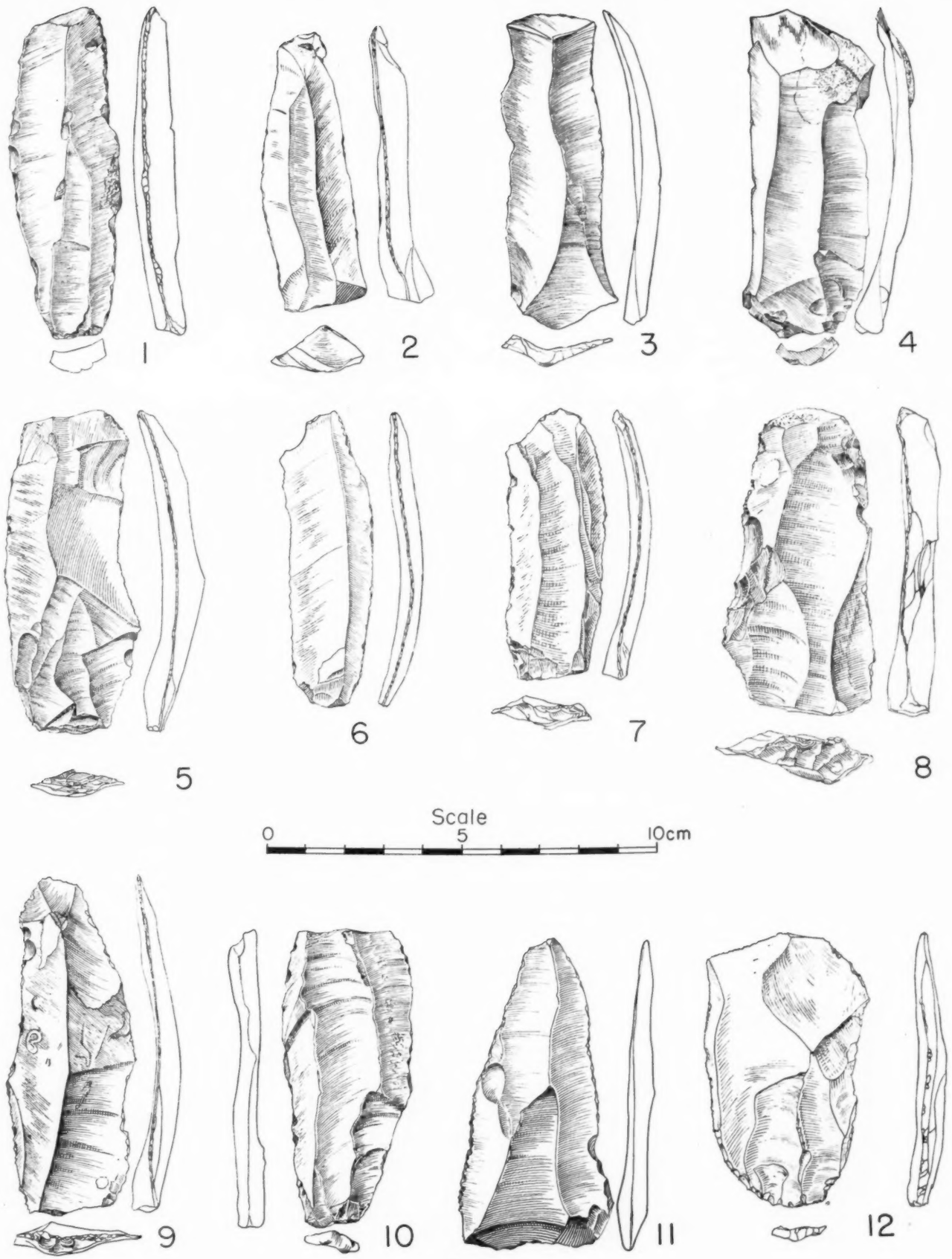


FIG. 42

FIG. 43. Blades and flake-blades.

1. A thick blade of intensely clouded grey flint with a slight patina, and unrolled. The striking-platform is missing owing to retouching on the lower surface, and the base of the percussion bulb has also been removed. The upper surface, which is primarily single-ribbed, shows some trimming on the left rear cutting edge. Otherwise, the cutting edges show coarse indentations made from both surfaces. This blade is one of the very few with the base trimmed away.

2. A blade of grey flint, slightly patinated, and unrolled. It has a small striking-platform with a few facets, and was made by the bone billet technique with a striking angle of 115°. The upper surface exhibits one main rib and nodular cortex toward the distal end. Both cutting edges are almost without indentations. This is a Levalloisian blade.

3. A flake-blade of translucent, grey flint, unrolled, and with a brownish patina. It has a small, faceted striking-platform at a right angle to the long axis, a prominent bulb of percussion, and a slight *S*-curvature. The upper surface exhibits several flake scars similar to the Levalloisian flakes. All of the cutting edges show small indentations.

4. A broad blade of grey flint, slightly patinated, and unrolled. It has a large faceted striking-platform at a right angle to the long axis, a prominent bulb of percussion, and a slight *S*-curvature. The upper surface shows two main ribs. Both cutting edges and the distal end exhibit indentations made from above and below. This is a Levalloisian blade.

5. A flake-blade of grey flint, slightly patinated, and unrolled. It has a faceted striking-platform at a right angle to the long axis, and a slight curvature. The upper surface exhibits several flake scars similar to the Levalloisian flakes. The right edge is steep and shows a few indentations, as does the left.

6. A flake-blade of cloudy, grey and olive-colored flint, unrolled, with a slight patina. It has a narrow, faceted striking-platform, which lies at a right angle to the long axis. The upper surface exhibits several flake scars. Both edges show indentations. The right distal edge was broken off in antiquity.

7. A flake-blade of light grey flint, scarcely patinated and unrolled. It has a narrow, faceted striking-platform and a striking angle of 100°. The upper surface exhibits several flake scars. The left edge shows over-all indentations made from below.

8. Cröbern. A small flake-blade of spotty, yellowish grey flint, somewhat rolled, and slightly patinated. There is no striking-platform, probably the result of the use of an intermediary tool. The upper surface has been trimmed by a blow at the rear. Both cutting edges show over-all indentations.

9. A single-ribbed flake-blade of spotty flint, rolled, and patinated brown. It has a faceted striking-platform at a right angle to the long axis, and a short, prominent bulb of percussion. Both cutting edges exhibit coarse indentations and traces of more recent rolling.

10. A blade of unrolled, dark grey flint. It has a large faceted striking-platform which lies at a right angle to the long axis. On the distal extremity, which originally ended in a round fracture, a curvature has been made toward the single-ribbed upper surface. Both edges exhibit coarse indentations: on the right, made from below; on the left, from above.

11. A very broad flake-blade of grey flint, unrolled, and slightly patinated light brown. It has a long, faceted striking-platform, which lies at a right angle to the long axis. The upper surface is double-ribbed with very fine straight indentations on the right distal cutting edge.

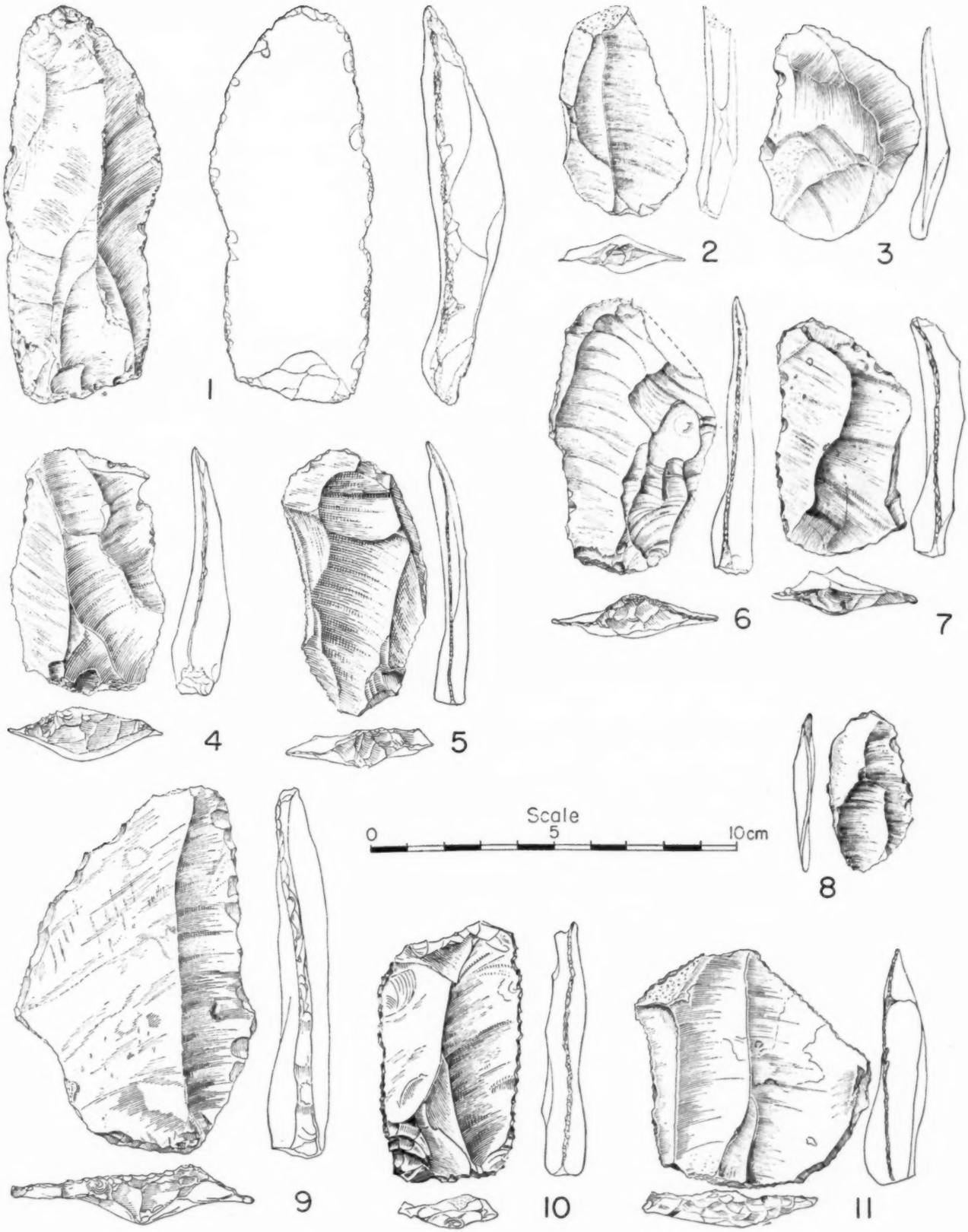


FIG. 43

FIG. 44. Blades.

1. A small, flat blade of translucent, olive-colored flint, scarcely patinated and unrolled. It has a small, plain striking-platform and a striking angle of 100°. The upper surface exhibits a number of flake scars. There are only a few indentations along the cutting edges.

2. A flat, single-ribbed, narrow blade of translucent, cloudy, grey flint, scarcely patinated and unrolled. It has a small, faceted striking-platform which lies at a right angle to the long axis. The cutting edges are without indentations. The right edge exhibits an old fracture.

3. A single-ribbed, narrow blade of light grey flint, unrolled, and with a rusty patina. It has a tiny striking-platform and is without indentations along the cutting edges.

4. A flat, narrow blade of translucent, light grey flint, slightly patinated and unrolled. The striking-platform was broken off in antiquity. The distal end consists of a round fracture. Both edges exhibit very fine retouching; the right from above, the left (in the rear) from below.

5. A single-ribbed, narrow blade of grey flint, scarcely patinated and unrolled. It has a small striking-platform and was probably made by using an intermediary tool. The distal end still shows some cortex and the cutting edges are without indentations.

6. A flat, narrow blade of olive-colored flint, patinated and unrolled. It has a small, plain striking-platform, a striking angle of 105°, and several flake scars on the upper surface.

7. A very flat, narrow blade of translucent, olive-colored flint, scarcely patinated and unrolled. It has a tiny striking-platform, an upper surface with several flake scars, and cutting edges almost without indentations.

8. A single-ribbed, narrow blade of banded, grey flint, patinated light brown and unrolled. It has a small, faceted striking-platform and a striking angle of 105°. The distal end was broken off in antiquity. The right cutting edge shows over-all indentations made predominantly from below. The left cutting edge shows coarse indentations in the rear, and fine ones toward the distal end.

9. A narrow blade of grey flint, patinated brown and unrolled. It was probably made by using an intermediary tool. There is a slight curvature, and the upper surface exhibits many flake scars. Both cutting edges show indentations made from above and below. The right edge displays a recent fracture.

10. A single-ribbed, narrow blade, unrolled, and with a rusty patina. It has a small striking-platform, a slight curvature, and fine, saw-tooth indentations along both cutting edges.

11. A flat, single-ribbed, narrow blade of translucent, spotty, grey flint, slightly patinated and unrolled. It was probably made by the intermediary tool technique. The distal end was broken off in antiquity. The left cutting edge shows over-all indentations made from above; the right, very fine saw-tooth indentations made from both surfaces.

12. A flat, double-ribbed, narrow blade of dark grey flint, with a brownish patina and almost unrolled. It has a faceted striking-platform. The over-all indentations along the cutting edges are made from below on the left, and from above on the right.

13. A flat blade of cloudy, olive-colored flint, slightly patinated and unrolled. It has a faceted striking-platform and a slight curvature. Both cutting edges show coarse indentations, mostly on the upper surface.

14. A flat blade of olive-colored flint, slightly patinated and unrolled. It has a narrow, faceted striking-platform and a slight curvature. The upper surface is generally single-ribbed, and both cutting edges show indentations.

15. A flat, single-ribbed blade of translucent, grey flint, with a brownish patina and strongly rolled. It has a plain striking-platform, which lies at a right angle to the long axis. The distal end consists of a round fracture. Both cutting edges show over-all indentations made mostly from above.

16. A flat, single-ribbed, narrow blade of translucent, grey flint, slightly patinated and unrolled. It has a faceted striking-platform, a striking angle of 95°, and is without indentations on the cutting edges.

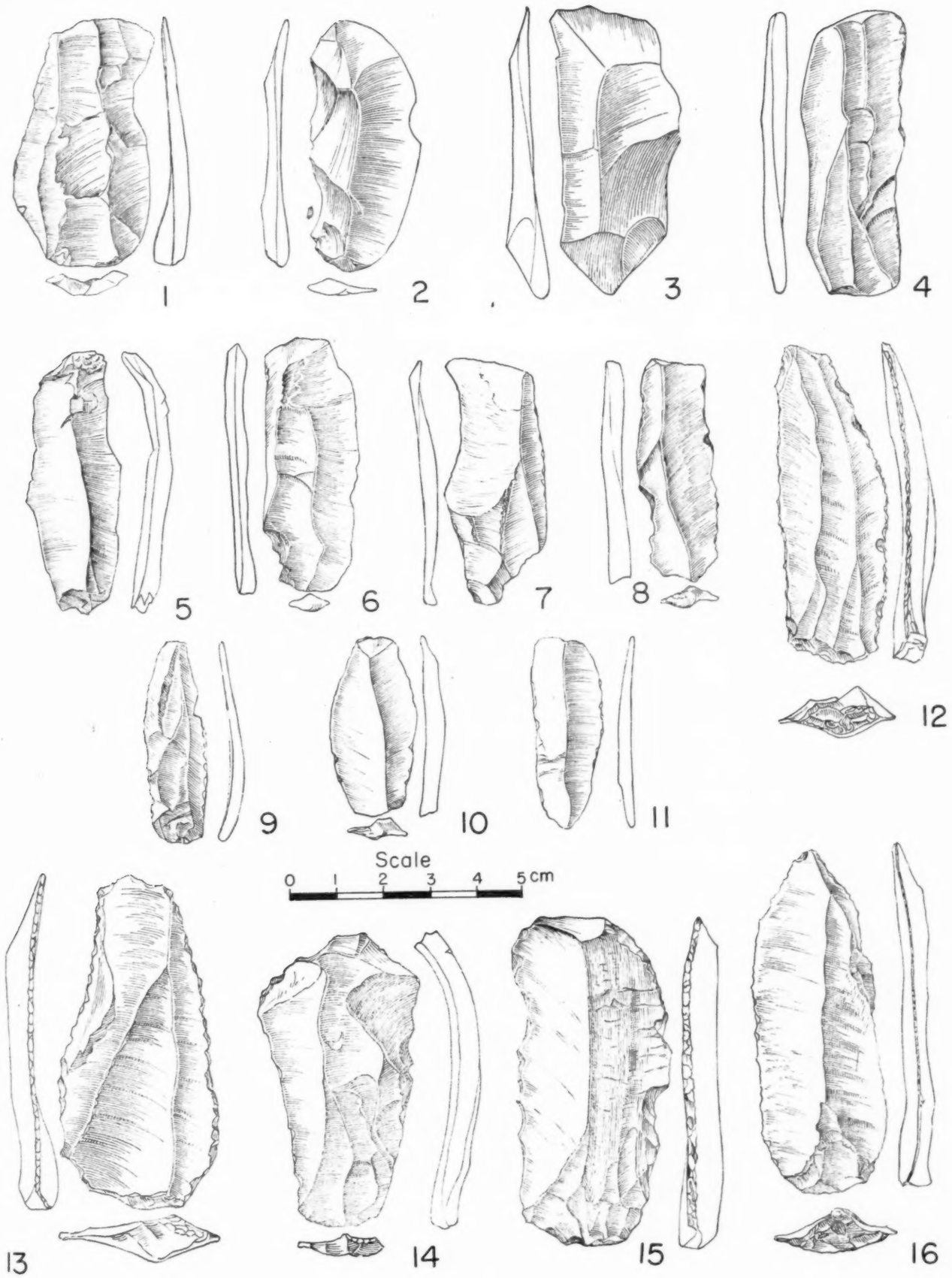


FIG. 44

FIG. 45. **Blades.**

1. A short, broad blade of light grey flint, slightly patinated and unrolled. It has a small, plain striking-platform, a striking angle of 110°, and was made by the stone-on-stone technique. The entire lower surface is covered by a prominent bulb of percussion. The upper surface exhibits a broad, primary flake scar in the center bordered by two ribs. The cutting edges show few indentations, but the straight distal cutting edge exhibits over-all indentations on the lower surface.

2. Zehmen. A thin flake of flint, patinated light brown and rolled. It has a small, striking-platform with a few facets, was made by the bone billet technique, has a striking angle of 100°, and exhibits several flake scars on the upper surface. The specimen, which has been rolled on all sides, may be considered a small Lavalloisian flake.

3. A short, broad blade of slightly spotty, dark grey flint, slightly patinated and unrolled. It has a long, extended striking-platform with facets, a striking angle of 105°, and a short, prominent bulb of percussion. The upper surface is double-ribbed and the right and distal edges exhibit some indentations.

4. A short, broad blade of light grey flint, slightly patinated and unrolled. It has a narrow, faceted striking-platform, was made by the bone billet technique, has a striking angle of 100°, and a short, prominent bulb of percussion. The upper surface exhibits a broad flake scar down the center bordered by two ribs. This technique is the same as that shown in two other examples (*cf.* fig. 45, nos. 1 and 3).

5. Zehmen. A fragment of a very thin blade of translucent, grey flint, slightly patinated and unrolled. The striking-platform is missing. The upper surface shows very flat flake scars. In general, the cutting edges exhibit over-all indentations made from below. The left one shows saw-tooth indentations.

6. A flake of translucent, light grey flint, slightly patinated and unrolled. It has a small, plain striking-platform, a striking angle of 110°, a slight curvature, and a short bulb of percussion. The upper surface is single-ribbed and the cutting edges are almost without indentations.

7. A flake-blade of light grey flint, slightly patinated, somewhat rusty, and unrolled. It was probably made by using an intermediary tool and shows light indentations, especially on the left cutting edge, where they are made from below.

8. A flake-blade of translucent, honey-colored yellow flint, slightly patinated and almost unrolled. There is no striking-platform. The upper surface is single-ribbed. The edges show indentations made from below.

9. Cröbern. A flake of translucent, honey-colored yellow flint, slightly patinated and unrolled. There is no striking-platform, and this specimen was probably produced by the intermediary tool technique. The upper surface is double-ribbed. Both cutting edges exhibit over-all indentations.

10. A narrow blade of translucent, olive-colored flint, slightly patinated and unrolled. It has a small striking-platform and a striking angle of 100°. The upper surface shows several ribs. For the most part the right edge is steep and blunt. The left edge exhibits over-all indentations on the lower surface.

11. A narrow blade of spotty, grey flint, scarcely patinated and unrolled. It has a tiny striking-platform, which lies at a right angle to the long axis. The cutting edges show a few very fine indentations on the lower surface.

12. A flake-blade of spotty, grey flint, slightly patinated, partly with a rusty covering, and unrolled. It has a small, narrow striking-platform, a slight curvature, and was made by the bone billet technique. The upper surface exhibits several flake scars. The cutting edges show no indentations.

13. A narrow blade of dark grey flint, unrolled, with an olive-colored patina. The upper surface has a single rib at the distal end and a double rib at the rear, providing a groove for hafting. Both cutting edges show extremely fine indentations, mostly on the lower surface.

14. A flake-blade of translucent, light grey flint, slightly patinated and unrolled. It was probably made by using an intermediary tool. Both side and distal cutting edges show indentations, made mostly from below, and traces of abrasion.

15. A narrow blade of spotty, grey flint, slightly patinated and unrolled. It has a small, plain striking-platform, a striking angle of 105°, and a slight curvature. The upper surface displays a single rib which forks toward the distal end. Both the cutting and distal edges exhibit indentations, mostly on the lower surface.

16. A narrow blade of translucent, grey flint, slightly patinated and unrolled. It has a small striking-platform with a short, prominent cone and bulb of percussion. The upper surface is mainly single-ribbed; the cutting edges show few indentations.

17. A blade of translucent, yellowish grey flint, hardly patinated and almost unrolled. There is no striking-platform. Possibly it was made by using an intermediary tool. The upper surface exhibits several flake scars. The cutting and distal edges show indentations, mostly on the lower surface.

18. Zehmen. A blade of grey flint, slightly patinated and unrolled. It has a tiny striking-platform, an upper surface with several flake scars and a steep, blunt right edge. The left cutting edge shows indentations, mostly on the upper surface.

19. Zehmen. A flake-blade, splayed at the distal end, of spotty flint, patinated an olive color, and rolled. The striking-platform and bulb of percussion have been trimmed away. The upper surface is single-ribbed and all edges show traces of rolling.

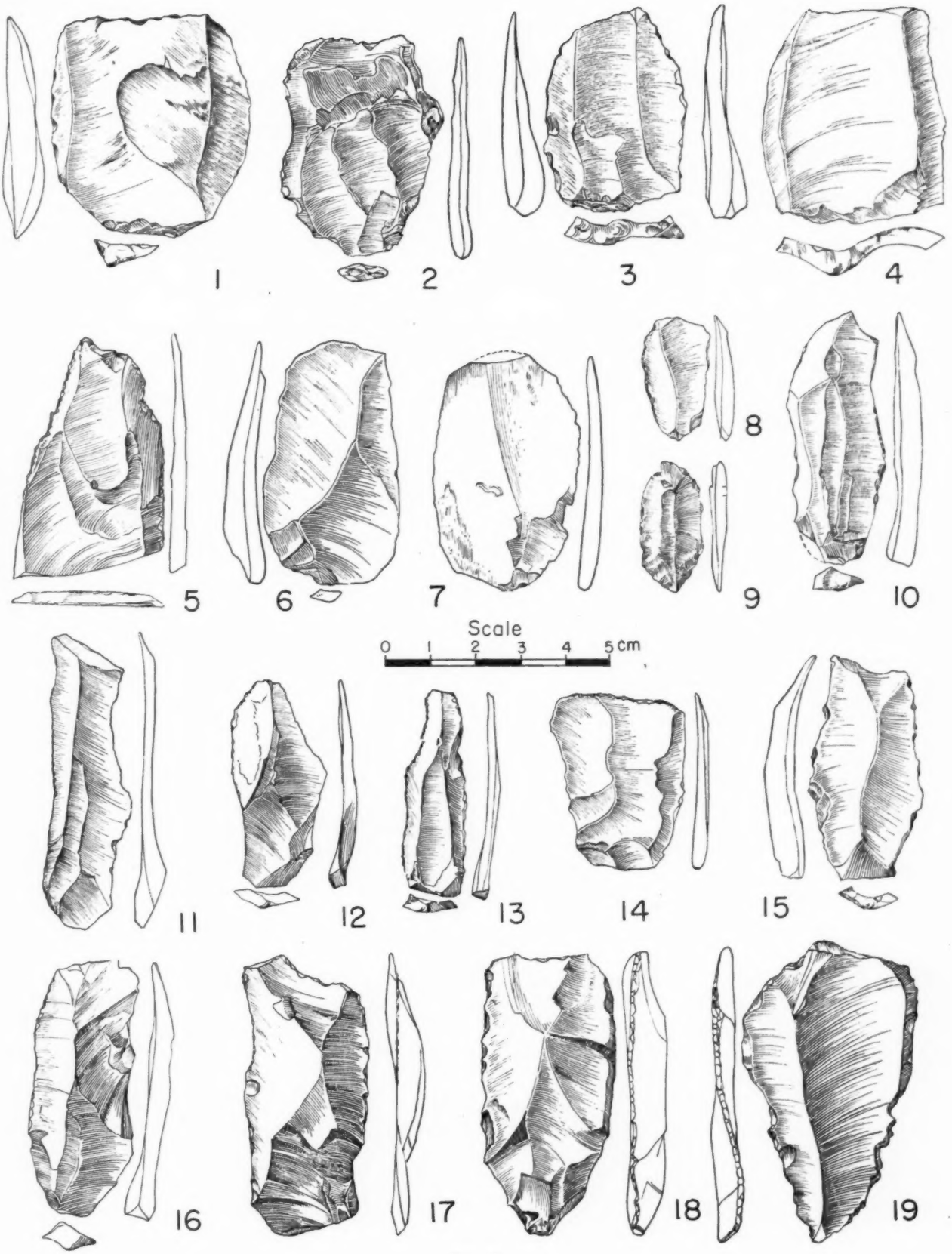


FIG. 45

FIG. 46. Retouched blades.

1. A retouched, thick blade of variegated grey flint, slightly patinated and unrolled. It has a large, faceted striking-platform at a right angle to the long axis, was made by the stone-on-stone technique, and has a short bulb of percussion. The upper surface shows one main rib and several secondary ones. The distal edge was broken off in antiquity. The left edge is finely retouched from above; it also shows a few indentations from below. The right edge exhibits over-all, short retouching, predominantly on the upper surface.

2. A blade, retouched along the right cutting edge, of grey flint, unrolled, with a brownish patina. It has a striking-platform with several facets, a striking angle of 100°, and an upper surface with many flake scars. The left edge is steep and blunt toward the rear, and sharp with a few indentations toward the distal end. The right edge shows over-all, mostly narrow, retouching along the upper surface.

3. A single-ribbed blade of variegated light and dark grey flint which is almost unrolled. It has a faceted striking-platform, was made by the stone-on-stone technique, and has a striking angle of 115°. The left cutting edge is blunt; the right, retouched.

4. A single-ribbed, narrow, retouched blade of grey flint, patinated brown, and unrolled. It has a faceted striking-platform, which lies at a right angle to the long axis. Both edges show simple indentations or retouching.

5. A single-ribbed, unrolled, flat blade of translucent, light brown flint. It has a faceted striking-platform, which lies at a right angle to the long axis. The left cutting edge is retouched. The right edge shows a few indentations. The distal end was broken in antiquity.

6. A double-ribbed, retouched blade of grey flint, patinated brown and unrolled. It has a small, trimmed striking-platform at a right angle to the long axis, and shows simple retouching along both edges. The distal end has been broken off. The left cutting edge has recently been fractured toward the distal end.

7. A fragment of a blade, retouched along the right cutting edge, of dark grey flint, slightly patinated and unrolled. It was made by the stone-on-stone technique, and has a faceted striking-platform, a striking angle of 85°, a short cone and a thick bulb of percussion. The upper surface retains part of the nodular cortex. The blade is broken at the left distal end, probably from use rather than purposely to form a point. The left cutting edge shows over-all indentations on the lower surface; the right, flat retouching.

8. A retouched, flat blade of variegated, light and dark grey flint with a shiny patina and slightly rolled. It has a coarsely prepared striking-platform, which lies at a right angle to the long axis. The upper surface exhibits several flake scars and was, especially on the right side, later retouched in two steps. Only short retouching occurs along the left cutting edge.

9. A narrow, double-ribbed blade of grey flint, patinated brown, partially rusty, and heavily rolled. It has a faceted striking-platform which lies at a right angle to the long axis. Both cutting edges show over-all retouching executed most carefully on the left distal end.

10. A single-ribbed blade, retouched along the right cutting edge, of dark grey flint, scarcely patinated, and unrolled. The striking-platform has been removed by blows aimed at the upper surface, which retains traces of nodular cortex at the distal end and in the rear. The left edge shows over-all indentations along the lower surface; the right, fine over-all retouching on the upper surface.

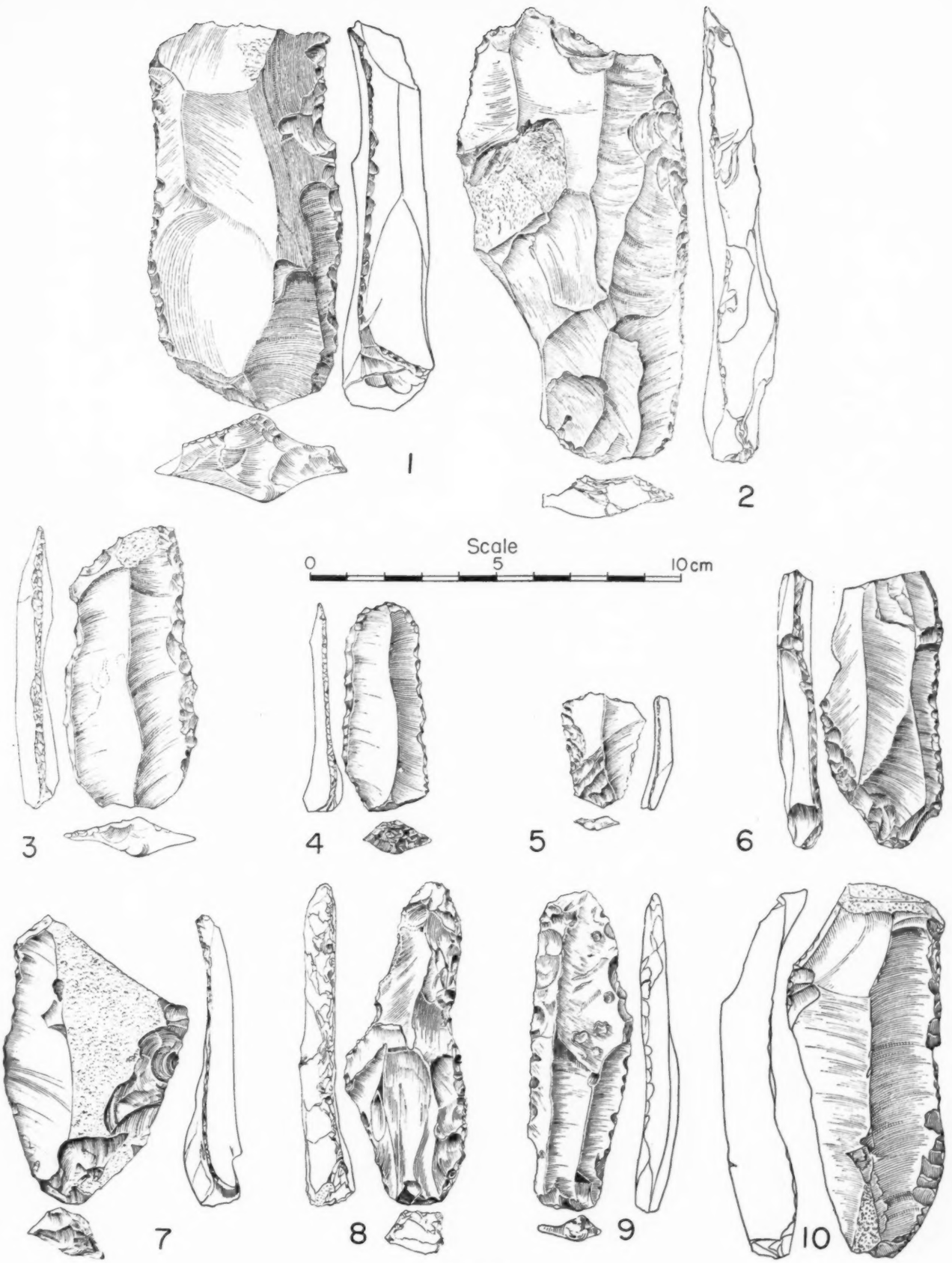


FIG. 46

FIG. 47. Retouched blades and oblique-ended blades.

1. A flat, double-ribbed, oblique-ended blade of flint, patinated rusty brown, and unrolled. It has a tiny striking-platform and was probably made by using an intermediary tool. The distal extremity has been shaped into an asymmetrical left-sided point either on purpose or accidentally. The cutting edges exhibit only very fine indentations.

2. A double-edged, trimmed blade of flint, patinated rusty brown, and unrolled. It has a trimmed striking-platform and a short bulb of percussion. The distal end was broken off in antiquity, apparently through use. It was later slightly rolled. The left cutting edge has been very neatly retouched in two steps; the right one, in a simpler fashion.

3. Zehmen. A single-ribbed, narrow blade of light grey flint, only slightly patinated and unrolled. It has a small, plain striking-platform at a right angle to the long axis, and was made by the bone billet technique. Both cutting edges have been retouched very neatly in one or two steps. The distal end was broken off, probably in antiquity.

4. A double-ribbed, rolled, blade of variegated dark grey flint. It has a small, faceted striking-platform, which lies at a right angle to the long axis. Both cutting edges are finely retouched. The distal end of the specimen has been broken off, apparently accidentally.

5. A coarse, double-ribbed, oblique-ended blade of opaque, light grey flint, unrolled, with a spotty, rusty patina. The originally pronounced bulb of percussion was removed by a later blow. The upper surface has been thinned in the right rear, possibly to aid in hafting. The distal end of the blade has been made oblique toward the right rear by a "graver" blow struck from the distal end. The left cutting edge shows over-all indentations made from above and below. The right edge exhibits over-all, short retouching.

6. A triple-ribbed, oblique-ended blade of grey flint, unrolled, with a yellowish patina. It has a small striking-platform which lies at a right angle to the long axis. The distal extremity has been broken off obliquely toward the right rear. The left part of the distal end has been broken away recently. Both cutting edges exhibit fine indentations; the left from below, the right from above.

7. A broad, oblique-ended blade of variegated flint, scarcely rolled; with a yellowish patina. It has a slightly trimmed striking-platform which lies at a right angle to the long axis. The upper surface exhibits a single rib which forks toward the rear. The distal extremity has been fractured obliquely toward the right rear. The right cutting edge is blunt; the left exhibits indentations made chiefly from below. There are traces of rolling.

8. A single-ribbed, broad, oblique-ended blade of variegated grey flint, slightly patinated and unrolled. It has a small, plain striking-platform and was formed by the hammerstone technique. The distal extremity is broken off toward the right rear, and the left edge shows numerous, coarse indentations made from above and below.

9. A single-ribbed, oblique-ended blade of variegated grey flint, slightly patinated and unrolled. It has a striking-platform with a few facets, at a right angle to the long axis, and shows some fine indentations, especially along the left cutting edge. The distal extremity was broken off in antiquity in such a way that the point of the specimen occurs at the right. It is uncertain whether this fracture was accidental or intentional.

10. A strongly curved, double-ribbed, oblique-ended blade of unrolled, translucent, olive-colored flint. It has a faceted striking-platform which lies at a right angle to the long axis. The distal extremity has been removed by a "graver" blow struck from the pointed end toward the right rear portion of the butt. The left cutting edge exhibits fine indentations made from below and above; the right, some indentations from below.

11. A double-ribbed, narrow blade of translucent flint, patinated brown and unrolled. It has a trimmed striking-platform, which lies at a right angle to the long axis. Both cutting edges show over-all indentations. The specimen is reminiscent of the Middle Palaeolithic; it has been previously described by Jacob-Friesen (1914: fig. 35).

12. A double-ribbed, unrolled, blade of variegated light and dark flint. It has a faceted striking-platform, which lies at a right angle to the long axis. The distal end and the sides are neatly retouched in two steps. The specimen is reminiscent of the Middle Palaeolithic.

13. A coarse, oblique-ended blade of grey flint, unrolled, with a brownish patina. It has a faceted striking-platform and a striking angle of 110°. The distal extremity has been broken off obliquely toward the right rear. Both distal and left cutting edges exhibit fine indentations.

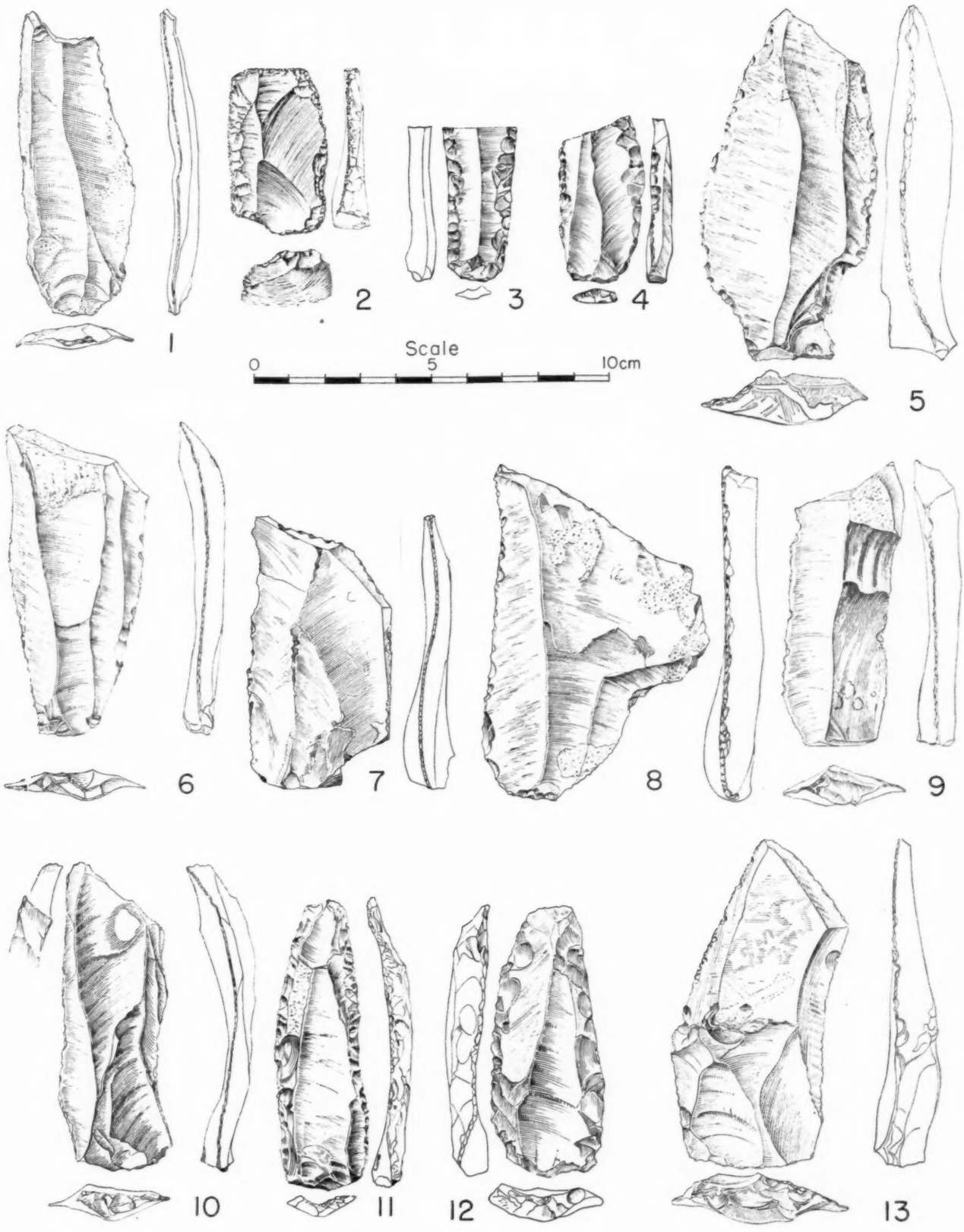


FIG. 47

FIG. 48. Oblique-ended blades, blades with side curvature, and blades with graver blows or awl-like points.

1. An oblique-ended blade of translucent, grey-black flint, slightly patinated and unrolled. It has a small, faceted striking-platform, was made by the stone-on-stone technique, and has a short bulb of percussion and striking angle of 100°. The upper surface exhibits a single rib which forks toward the rear. The distal extremity has been removed by an oblique fracture, so that a point is present toward the left distal end. This point is accentuated by a "graver" blow struck toward the left edge, which also exhibits indentations mostly made from the lower surface. The right cutting edge has an artificial curvature as the result of short retouching along the lower surface.

2. An oblique-ended blade of translucent, yellowish grey flint, slightly patinated and almost unrolled. The striking-platform has been removed by trimming blows struck toward the upper surface, which is single-ribbed. The distal extremity has been removed by a blow struck toward the left. The left cutting edge exhibits over-all indentations made both from above and below. The right edge also shows a few indentations.

3. An oblique-ended blade of dark grey flint which shows the beginning of white patination. This specimen apparently does not belong to Preservation Group 1, however, for adhering remnants indicate that it probably lay at the base of the sandy loess, in which case it received the white patina only in the Riss-Würm Interglacial. It is unrolled, has a plain striking-platform, and was made by the bone billet technique with a striking angle of 120°. The upper surface is double-ribbed with the distal extremity broken away or struck off toward the left. The cutting edges are almost without indentations.

4. An oblique-ended blade of spotty, bryozoa-carrying, grey flint, slightly patinated and unrolled. It was made by the bone billet technique and has a small, plain striking-platform, a striking angle of 110°, and a single-ribbed upper surface. The right part of the distal end is broken off so that a point occurs at the end of the rib. Both cutting edges exhibit a few indentations.

5. Zehmen. A broad, oblique-ended blade of spotty, grey flint, slightly patinated and unrolled. It was made by the stone-on-stone technique and has a plain striking-platform, a cone, a short, thick bulb of percussion, and a striking angle of 125°. The upper surface exhibits several flake scars, one of which is located in the rear for thumb support or hafting. The distal extremity received a cutting edge, as the result of several blows, which run toward the right. The right cutting edge exhibits indentations.

6. A narrow, oblique-ended blade of grey flint, patinated an ochreous-yellow color and unrolled. It has a small, faceted striking-platform and a pronounced curvature. The upper surface is primarily double-ribbed. The right side of the distal extremity is purposely fractured, forming a point at the end of the rib. Both cutting edges exhibit a few indentations.

7. A blade with a side point, of light grey flint, slightly patinated and unrolled. It has a small, plain striking-platform, a striking angle of 100°, and a slightly developed bulb. The upper surface, which has a single rib forking toward the distal end, has been thinned toward the rear with stepped blows. The left cutting edge shows over-all indentations, mostly on the lower surface. The right rib on the upper surface ends in a point produced by "graver" blows.

8. A narrow, triangular blade with an awl-like point, of light grey flint, patinated yellow, and almost unrolled. It was made by the bone billet technique, has a plain striking-platform and a striking angle of 105°. The point was formed not by a "graver" blow, but by several small retouching blows made near the indentation.

9. A flat, single-ribbed blade with an awl-like point, of light grey flint, slightly patinated and unrolled. It has a small striking-platform and a short, thick bulb of percussion. The upper surface has been thinned by a blow in the rear. The point was produced by fine retouching. This blade was first described by Jacob-Friesen (1914: fig. 63).

10. A single-ribbed blade with narrow awl-like point, of spotty, light grey flint, slightly patinated and almost unrolled. The striking-platform is missing although the bulb is partly preserved. The specimen exhibits a slight curvature. Both cutting edges show over-all indentations made from above and below. The edges intersect at a point formed by retouching.

11. A double oblique-ended blade of spotty, grey flint, slightly rolled, with a rusty brown patina. It was made by the stone-on-stone technique, and has a narrow, plain striking-platform, a striking angle of 100°, a short, thick bulb of percussion, and a slight *S*-curvature on the lower surface. The upper surface exhibits a broad, central scar with two side ribs. The distal extremity was broken off to form a vertical cutting edge which runs to the left of the longitudinal axis, and which shows traces of use.

12. A double-oblique-ended blade of translucent, grey flint, unrolled, with a slightly brownish patina. It was made from a flake-blade and has a flat upper surface with steep edges on both sides. The distal end of the flake was formed into a symmetrical point by breaking off both sides. The right edge is somewhat retouched. The point, probably used as an awl, shows indentations resulting from use. The left edge is finely retouched toward the rear. The right edge exhibits a curvature which almost made a second awl point on the rear part of the flake.

13. An unrolled blade of grey flint which becomes darker toward the chalky cortex. It has a triangular, faceted striking-platform and a striking angle of 95°. The left half of the distal end of the blade has been removed by a heavy blow from the point. This was a genuine "graver" blow. The point shows no traces of use. Both cutting edges exhibit coarse indentations.

14. A single-ribbed blade with a "graver" blow, of spotty, light grey flint, rolled and slightly patinated. It has a small striking-platform with coarse facets, a short bulb and a slight curvature. The left edge is retouched along its entire length on the upper surface. The right edge exhibits coarse indentations, especially along the lower surface. The right half of the distal end of the blade was removed by a heavy blow from the point. The lack of traces of usage on the point makes it impossible to determine whether or not this blow, which is a true "graver" blow, was intentional.

15. A blade with side curvature of light grey flint, rolled and patinated an ochreous yellow color. It was made by the bone billet technique, has a somewhat faceted striking-platform at a right angle to the long axis, and displays a flat bulb with a long projection. The distal extremity ends in a round fracture. The upper surface has a single middle rib. The left edge shows over-all indentations on both surfaces. The right side has been thinned by two blows struck toward the upper surface. The right cutting edge exhibits indentations made from above, with the formation of a small curvature toward the rear.

16. A blade with side curvature, of spotty, translucent, dark grey flint, unrolled, and only slightly patinated. The striking-platform was removed in the process of trimming off the bulb of percussion. The upper surface exhibits a single middle rib. The left edge shows a few indentations; the right is sharp at the distal end with a small curvature neatly worked out toward the rear. It appears that the rear part of the blade was used.

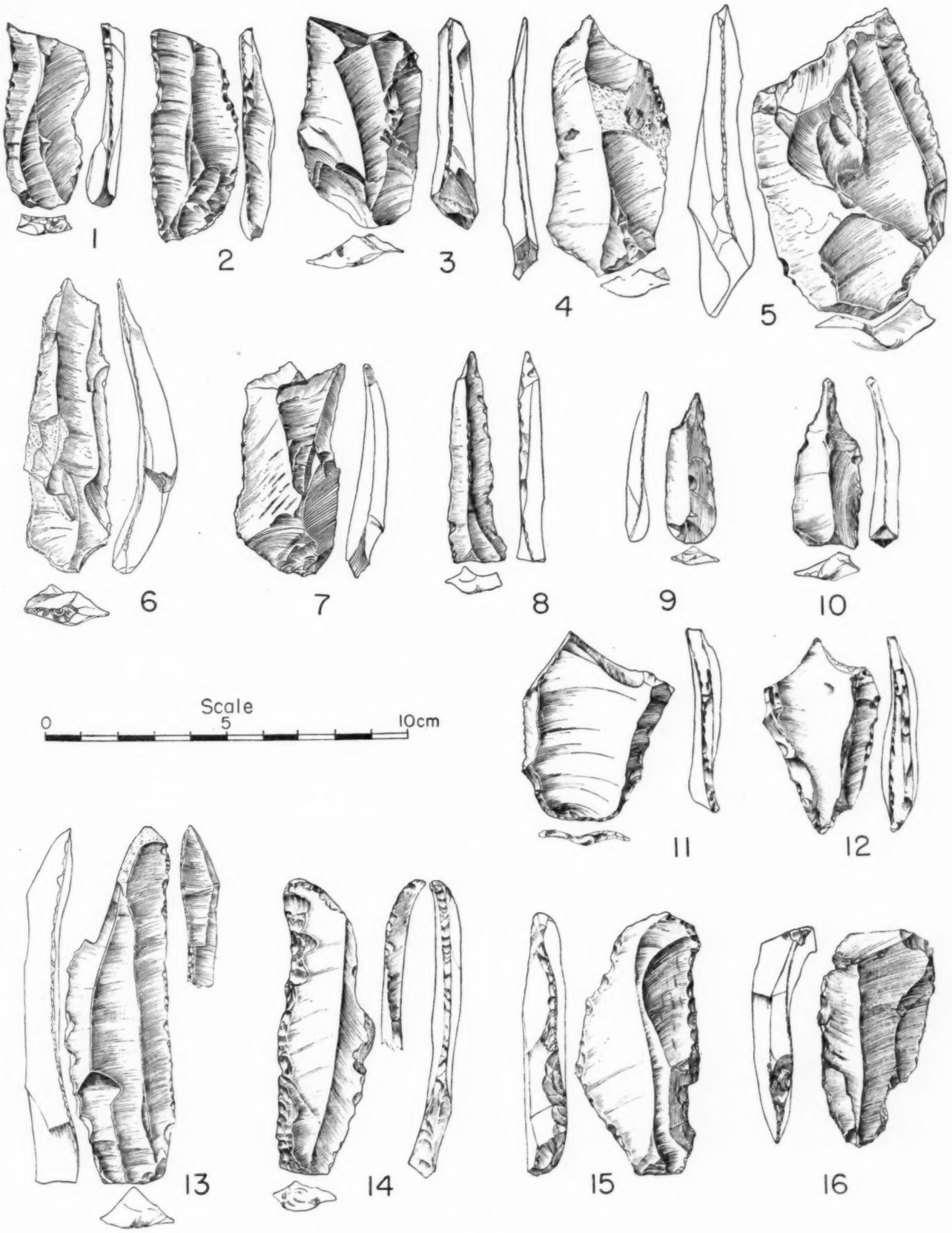


FIG. 48

FIG. 49. Flat quadrangular and transverse flakes and a double oblique-ended blade.

1. A quadrangular flake of bryozoa-carrying, grey flint, unrolled and almost unpatinated. It was made by the stone-on-stone technique, has a plain striking-platform, and a striking angle of 90°. The upper surface is mostly double-ribbed. The right rear edge of the specimen was broken off in antiquity. The left cutting edge shows over-all, saw-tooth indentations. The distal and right cutting edges exhibit indentations made from above.

2. A quadrangular Levallois-type flake of translucent, olive-colored flint, slightly patinated and unrolled. It has a faceted striking-platform and a striking angle of 105°. The upper surface exhibits several flake scars. The distal end shows a prepared curvature. All edges have indentations made mostly from above.

3. A quadrangular Levallois-type flake of light grey flint, unrolled and partially covered with a rusty patina. It has a faceted striking-platform which lies at a right angle to the long axis. The upper surface exhibits several flake scars. The cutting edges show indentations: on the left, made from below; on the right, mostly from above.

4. A thick, oval, transverse flake of very light grey flint, unrolled, with a light brown patina. It was probably made by using an intermediary tool. The upper surface shows many flake scars. The edges are unworked.

5. A transverse flake of spotty, grey flint, slightly patinated and unrolled. It was probably detached by the intermediary tool technique. The upper surface shows several flake scars. The distal extremity exhibits a prepared curvature. The left cutting edge shows indentations made from both surfaces.

6. A transverse flake of rolled, spotty, dark grey flint. The upper surface is shiny while the lower one has a somewhat rusty patina. It was made by the stone-on-stone technique, and exhibits a small, plain striking-platform, a prominent bulb of percussion, and a striking angle of 100°. The upper surface shows several flake scars and a section of white nodular cortex. The distal end was used as a cutting edge and shows steep retouching forming a curvature and point. Thus the flake may also be classified as a curved side-scraper.

7. A quadrangular Levallois-type flake of very light grey flint, unrolled, with a dull patina. It has a faceted striking-platform which lies at a right angle to the long axis. There are three flake scars on the upper surface. The left cutting edge shows indentations made from below. The distal end exhibits indentations made mostly from above.

8. A quadrangular Levallois-type flake of unrolled, dull grey flint. It has a curved, faceted striking-platform at a right angle to the long axis, and the upper surface shows several flake scars. The cutting edges all exhibit indentations made from both above and below. The center and distal end of the right cutting edge has been made into a small curvature. There are traces of recent abrasion.

9. A Levallois-type flake of cloudy, dark grey flint, scarcely patinated, and unrolled. It has a large, faceted striking-platform at a right angle to the long axis, an *S*-curvature, and an upper surface with several flake scars. The distal extremity exhibits prepared curvatures. Both cutting edges show indentations: on the left, made from both surfaces; on the right, over-all short retouching done from above.

10. A double oblique-ended blade of grey-brown flint, unrolled, with a brown patina. The original striking-platform, which was probably large and unfaceted, has been removed by a blow struck from the side. Part of the pronounced bulb remains. Most of the upper surface consists of nodular cortex on which glacial striations are visible. The distal end of the flake was probably formed into a vertical cutting edge by blows struck from that end toward the left. This cutting edge shows slight traces of use. A heavy blow from the distal end removed the left part of the upper surface. The left edge exhibits indentations made from above.

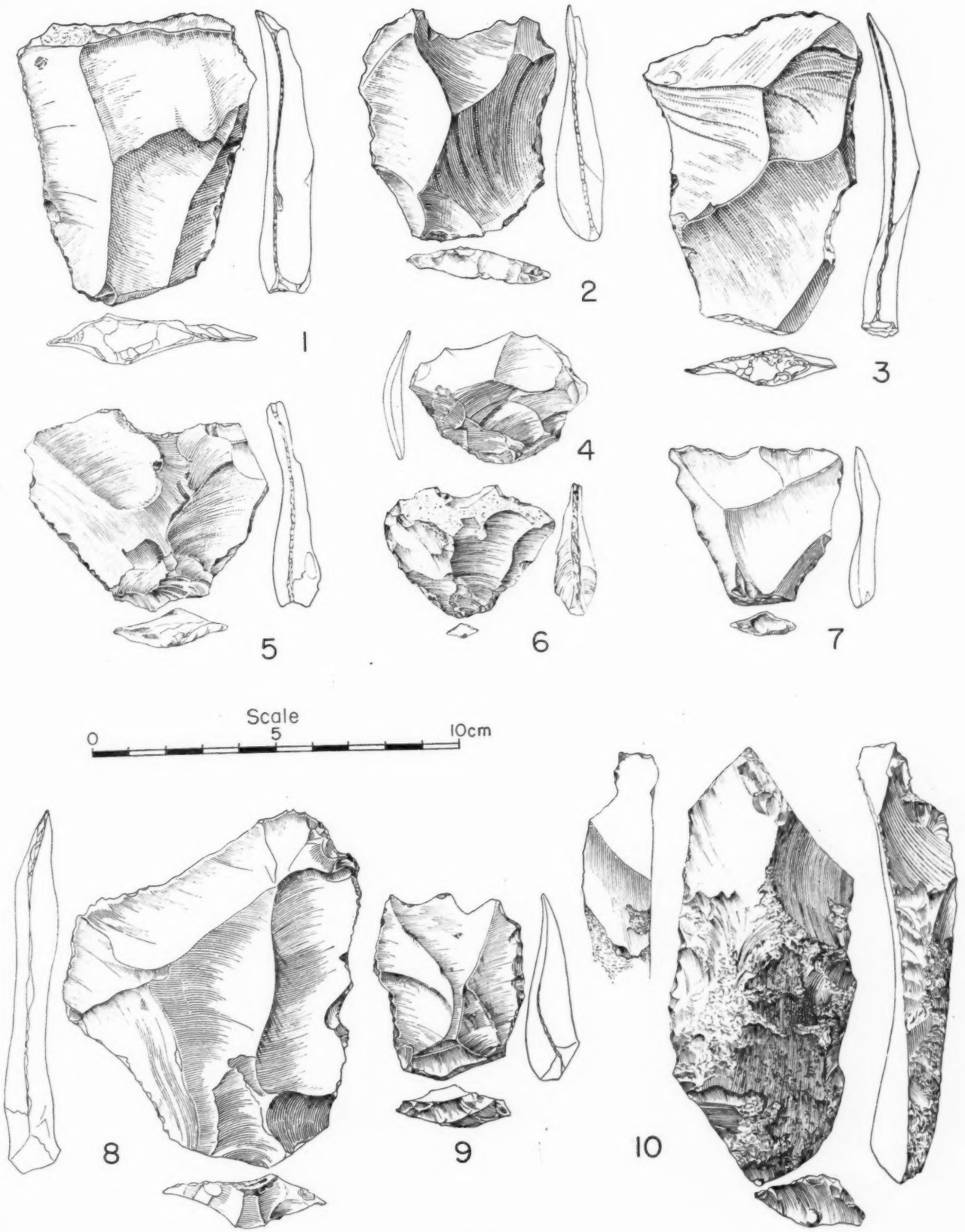


FIG. 49

FIG. 50. Flat oval, round and quadrangular flakes, and transverse flakes.

1. A broad, trapezoidal flake of grey flint, slightly patinated and unrolled. It has a large, plain striking-platform, a thick bulb of percussion, and a striking angle of 95°. The upper surface shows two ribs which fork toward the distal end. The distal end has been retouched to form a curvature. The left cutting edge exhibits over-all indentations, while the right edge shows two prepared curvatures.

2. A trapezoidal flake of dark grey flint, unrolled, with a dull patina. The upper surface exhibits some rust stains, and has a middle rib which forks toward both corners of the distal extremity. There is a large striking-platform with a few facets, a prominent bulb of percussion, and a striking angle of 100°. All cutting edges show over-all indentations.

3. A round flake of spotty, grey flint, slightly patinated and unrolled. It was manufactured by a hammerstone blow on the nodular cortex. The bulb of percussion covers almost the entire lower surface. The upper surface exhibits percussion ripples. The edges show only a few indentations, so that it is uncertain that this flake ever served as an implement.

4. A large, broad flake of grey flint, slightly rolled, with a heavy grey-brown patina. It was made by the stone-on-stone technique, and has a large striking-platform with a few facets, a large bulb of percussion, and a striking angle of 100°. The upper surface has a main rib which forks toward the distal extremity. This extremity has been formed into a slight curvature. The cutting edges show indentations on the upper surface. There are also more recent traces of rolling.

5. A large, flat flake of banded, grey flint, slightly patinated light brown and unrolled. It was made by the stone-on-stone technique, and has a long, extended, plain striking-platform, a cone, prominent bulb of percussion, and a striking angle of 120°. The upper surface exhibits several flake scars, and both edges show a few indentations. The surface treatment permits this artifact to be classified as a Levallois-type flake, although such a classification is not supported by the striking technique.

6. A flat Levallois-type flake of banded, light grey flint, patinated light brown, and unrolled. It has a retouched striking-platform which lies at a right angle to the long axis. The upper surface exhibits several flake scars and an area of cortex toward the left rear. The edges show over-all indentations.

7. A round flint flake, heavily patinated grey-brown, and unrolled. It was made by the bone billet technique, and has a plain striking-platform at a right angle to the long axis, a prominent bulb, and an upper surface with several flake scars. All edges exhibit indentations or traces of abrasion.

8. A round flake of grey flint, heavily rolled and partly patinated with a spotty olive-to-rusty brown patina. It has a faceted striking-platform at a right angle to the long axis, and a prominent bulb of percussion. The upper surface shows three flake scars. The heavily rolled edges probably originally exhibited indentations.

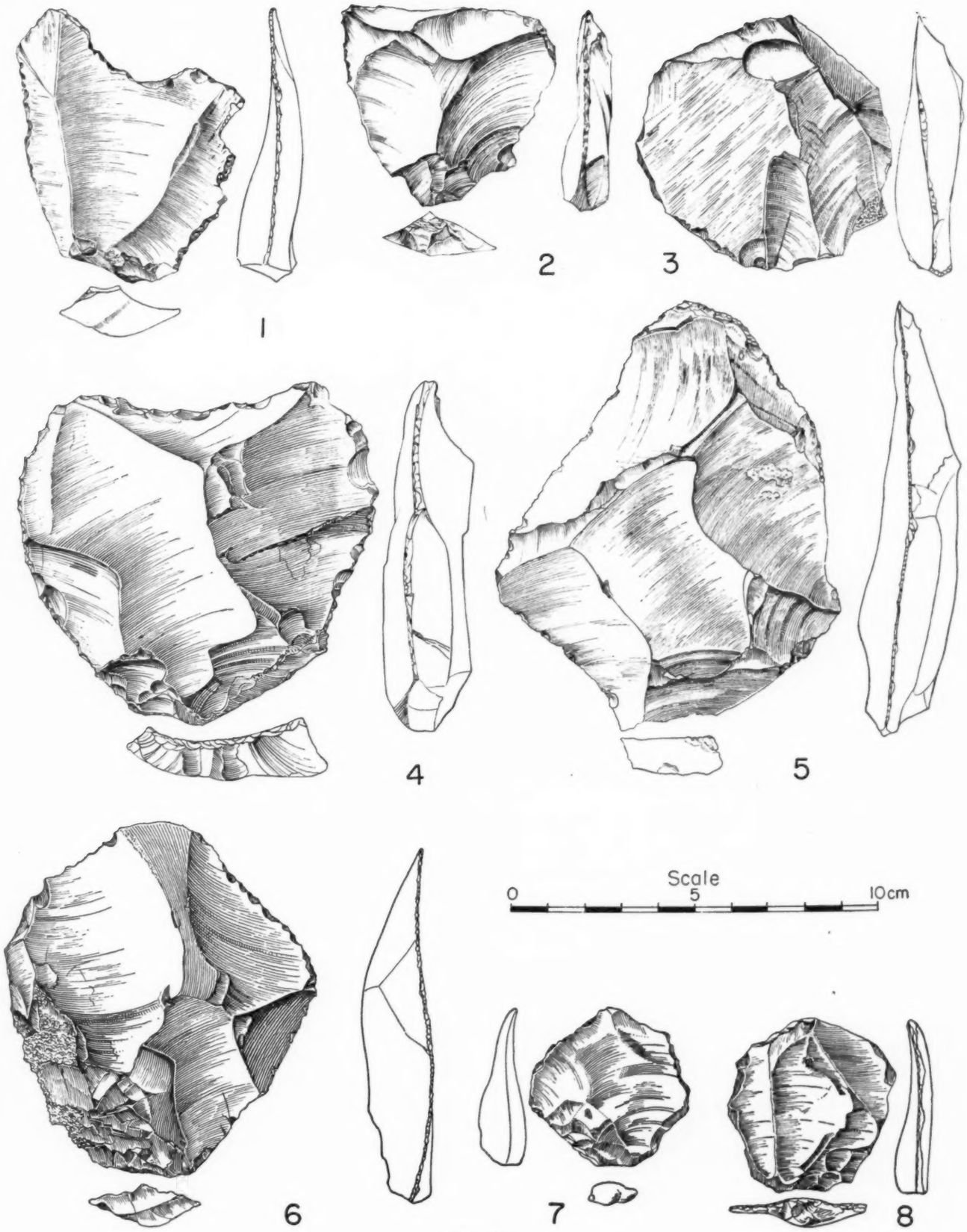


Fig. 50

FIG. 51. Flat oval and round flakes, and thick points.

1. A very thin, round Levallois-type flake of grey flint, unrolled, with a brownish patina. It has a small, faceted striking-platform and a sharply defined and prominent bulb of percussion. The edges show a few indentations. The upper surface exhibits many flake scars.

2. A round flake of spotty, grey flint, unrolled, with a brownish patina. It was made by the bone billet technique, and has a faceted striking-platform, a slight curvature, and a striking angle of 90°. The flat upper surface exhibits several flake scars. The edges show only very slight indentations. This specimen may be classified as a genuine Levallois-type flake.

3. A round flake of greyish-black flint, patinated brown and unrolled. It shows stepped flaking and was probably struck off by using an intermediary tool. The flat upper surface exhibits several flake scars. Both edges show irregular indentations made from above and below.

4. Zehmen. An oval flake of translucent, grey flint, patinated a brownish-olive color, and slightly rolled. It has a large, plain striking-platform at a right angle to the long axis, and a prominent bulb. The upper surface exhibits several flake scars. The distal end of the right edge shows a prepared curvature. All edges are coarsely retouched and show traces of rolling.

5. An oval flake of variegated grey flint, slightly patinated and unrolled. The striking-platform has been removed by later flaking, but part of the bulb of percussion is still present. The upper surface exhibits a single rib. The right edge shows simple retouching done from above toward the rear. The left is retouched from below in the rear and from above toward the point.

6. A broad, nearly oval flake of light and dark grey flint, with a brownish patina, and fresh, sharp edges. It was made by the bone billet technique, and has a large, plain striking-platform, a short, thick, prominent, bulb of percussion, and a striking angle of 100°. The upper surface exhibits one rib which forks toward the distal extremity. This surface has been thinned by the removal of several flakes toward the rear. The left edge shows over-all indentations on the upper surface. All of the other edges show indentations made by use.

7. A heavy flake of grey flint, deeply patinated brown, and slightly rolled. The cutting edges show the beginning of white patination. It has a very small striking-platform at a right angle to the long axis, and many flake scars on the upper surface. The bulb of percussion has been struck off by a later blow. The edges show fine indentations made mostly on the lower surface.

8. An oval flake of flint, patinated brown and unrolled. It was made by the stone-on-stone technique, and has a large, plain striking-platform and a striking angle of 100°. The upper surface exhibits flake scars. The left edge is steep and blunt. The right and distal cutting edges show almost over-all indentations.

9. A pointed, oval flake of grey flint, very heavily rolled, deeply patinated and rusty. It has a plain striking-platform, a prominent bulb of percussion, a slight curvature, and a striking angle of 100°. The upper surface exhibits several flake scars. The irregular edges are heavily rolled. A very similar flake was described by Jacob-Friesen (1914: fig. 7).

10. Zehmen. A thick point of spotty, grey flint, slightly rolled, with a light-to-rusty-brown patina. The originally large, plain striking-platform has been narrowed by a later blow on the upper surface. There are a projecting cone, a prominent bulb of percussion, and a striking angle of 110°. The upper surface shows a heavy main rib, some surface treatment on the right, and an area of cortex toward the right rear. Both edges exhibit coarse simple retouch, especially on the right. The retouch is all on the upper surface. The point was broken off from the left distal end toward the right rear. It is uncertain whether or not this specimen was used in the same way as the one illustrated in figure 51, no. 11.

11. A thick point of spotty flint, patinated light brown and unrolled. The original large, plain striking-platform has been thinned by more recent blows on the upper surface. There are a distinct percussion cone and a striking angle of 110°. The upper surface has three heavy ribs, with the left side showing further surface preparation. Both edges exhibit over-all indentations: the right one only from above; the left, very coarsely from below as well. The point was broken off in antiquity from the left distal extremity toward the right rear (*cf.* fig. 51, no. 10).

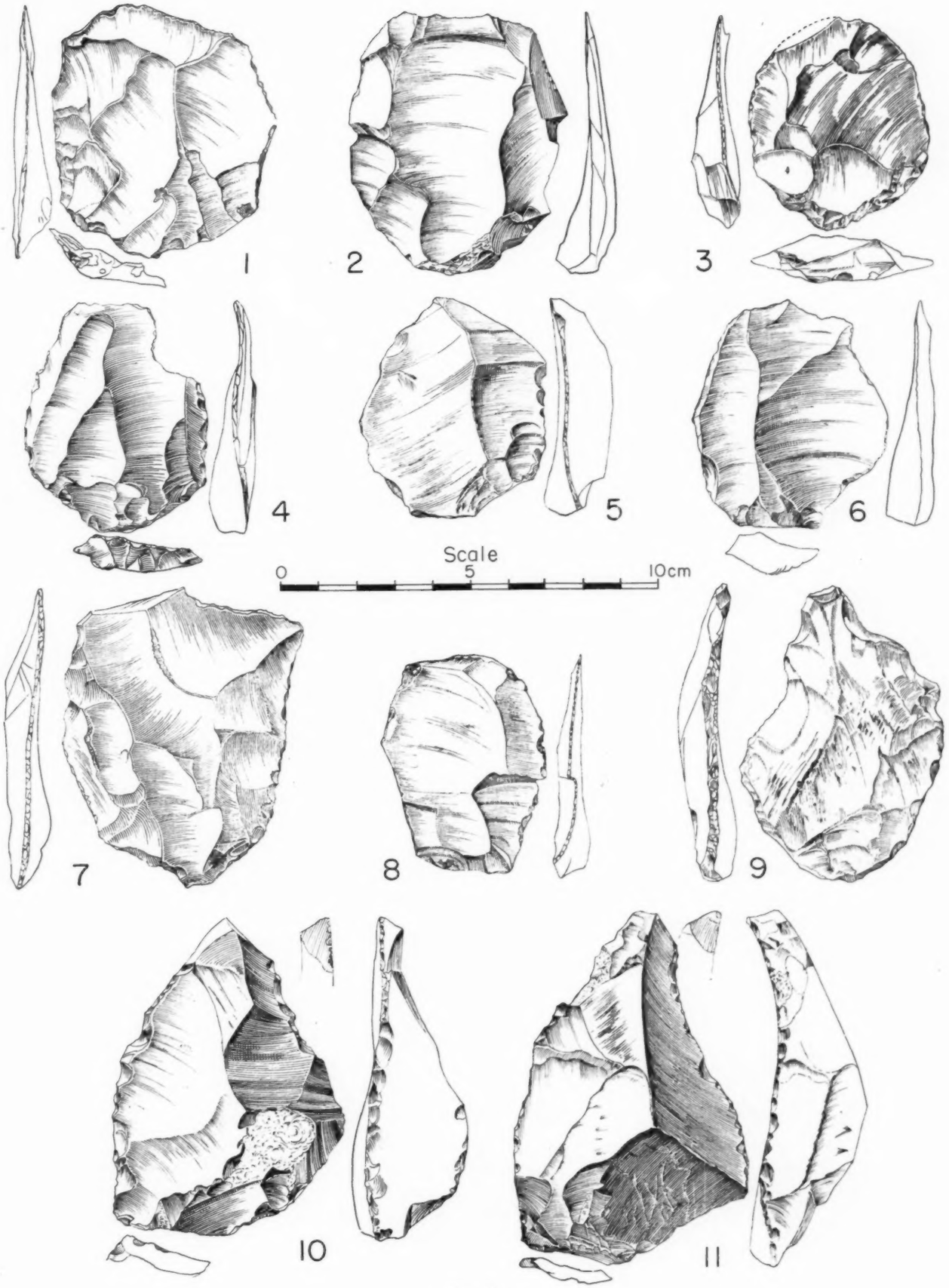


FIG. 51

FIG. 52. Thick points.

1. An asymmetrical, thick point of light grey flint, partially covered with a rusty patina, and unrolled. The originally large, plain striking-platform was reduced to a narrow strip by a later slanting blow on the upper surface. There is a distinct bulb of percussion and a striking angle of 125°. The upper surface is double-ribbed. Both edges are without indentations.

2. An asymmetrical point of mottled grey flint, scarcely patinated, and unrolled. It has a plain striking-platform trimmed down by more recent blows from the upper surface. There is a prominent bulb of percussion and a striking angle of 120°. The upper surface is single-ribbed with some surface preparation toward the left rear. The right rear corner of the point, which was probably thicker originally, has been trimmed. The left edge shows coarse over-all indentations made from below. The right edge exhibits fine over-all indentations made from above. The point is directed toward the left and shows no special treatment.

3. An asymmetrical, thick point, patinated brown and unrolled. The plain striking-platform has been trimmed down by a slanting blow on the upper surface. The cone of percussion and bulb are scarcely developed, the striking angle is 120°, and the upper surface is double-ribbed with an area of nodular cortex. The edges and the point show no further traces of preparation or use.

4. A rounded, thick point of partly banded, olive-colored flint which has been slightly rolled. It has a plain, narrow striking-platform, a slight curvature, a striking angle of 105°, and several flake scars on the upper surface. The left edge exhibits fine over-all retouching done from above. The right edge shows fine retouching near the distal end, but only single indentations toward the rear.

5. A rounded, thick point of translucent flint, patinated an ochreous brown, and unrolled. The plain striking-platform has been trimmed down by a slanting blow on the upper surface. There is a poorly developed bulb of percussion, and a striking angle of 120°. The upper surface exhibits a main rib which forks toward the distal extremity, and some surface preparation along that extremity. Both edges show over-all indentations, especially on the lower surface.

6. A narrow, thick point of spotty, grey flint, very slightly patinated, and unrolled. The striking-platform has been removed and the butt end thinned by stepped flaking. The upper surface shows one main rib and a secondary, somewhat less distinct, rib on the left. Both edges exhibit a few indentations. There is some retouching toward the left of the point on the distal end.

7. A symmetrical, thick point of grey flint, patinated light brown, and almost unrolled. It has a plain striking-platform with two cones, multiple points of impact, and a striking angle of 105°. The upper surface is mainly single-ribbed. The surface has been prepared by a stone-on-stone blow, as shown by the cone of percussion toward the left rear. The right edge exhibits some indentations made from above. The left shows either over-all indentations made from below, or retouching of the simplest kind. The point has been made blunt from the left distal end toward the right rear.

8. A narrow, thick point of bryozoa-carrying, grey flint, patinated grey-brown, and slightly rolled. It has a small striking-platform, a cone, and a striking angle of 100°. The upper surface exhibits a main rib with a smaller, secondary one to the left. To the left rear the upper surface has received further preparation. The left rear corner of the specimen has been removed. The shape is suggestive of the pointed half bifaces of the Micoquian, but the preparation of the upper surface is quite different.

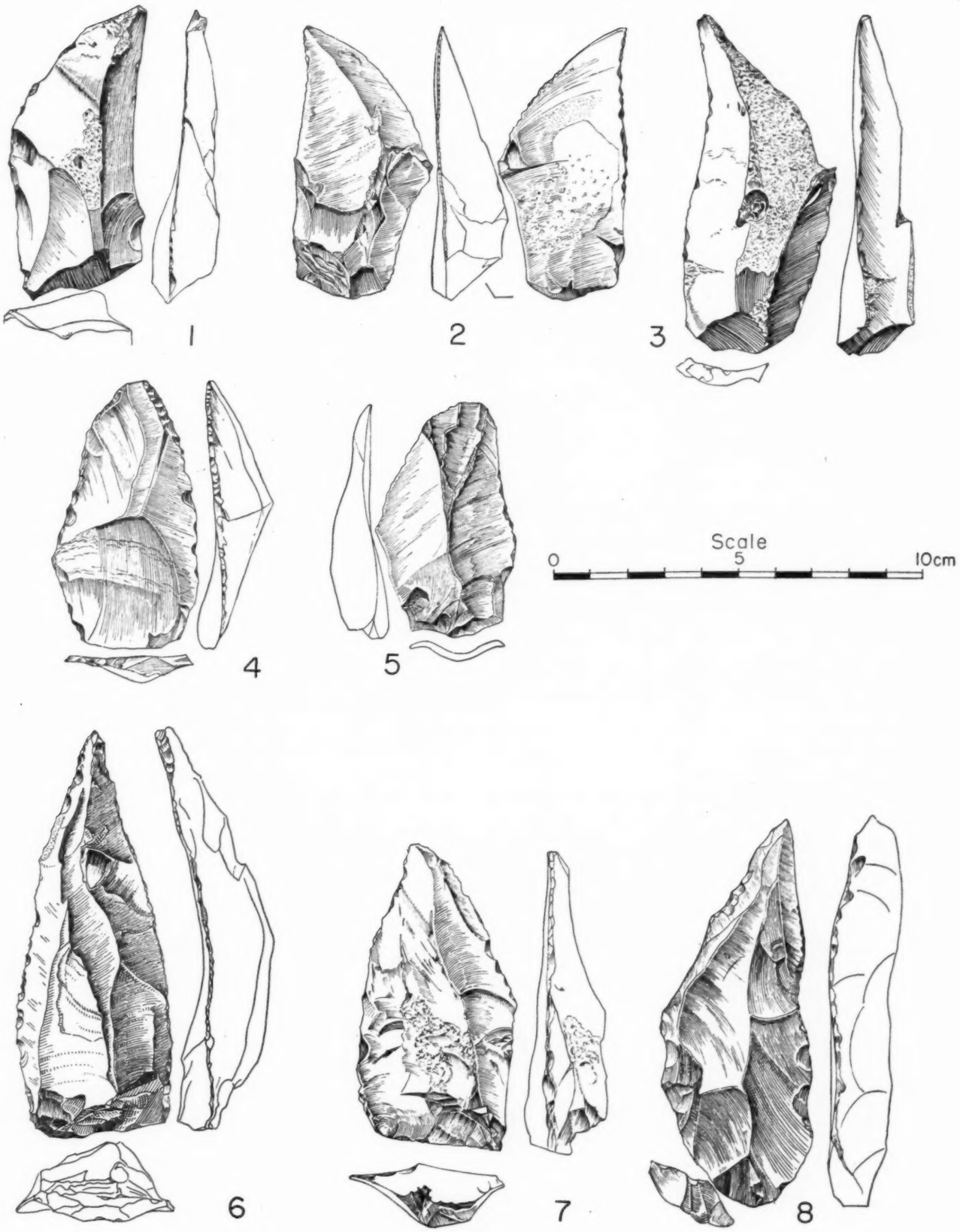


FIG. 52

FIG. 53. Thick points and flat points.

1. A triangular point of light grey flint, patinated light brown, and slightly rolled. It has a small, plain striking-platform, a prominent bulb, a striking angle of 120°, and was made by the stone-on-stone technique. Both edges show indentations, made especially from below, and traces of rolling.

2. A triangular point of banded, light grey flint, patinated a creamy brown, and rolled. It has a small, plain striking-platform and a striking angle of 105°. The right edge shows narrow, over-all retouching. The left edge exhibits a few projections.

3. Cröbern. A point of translucent, honey-brown flint, heavily patinated and rolled. The striking-platform cannot be recognized. The upper surface exhibits a few flake scars. The edges, probably with over-all narrow retouching originally, have been rounded through rolling.

4. Zehmen. A point of translucent, honey-brown flint, rolled, and with a shiny patina. It has a large, plain striking-platform, a striking angle of 120°, and several flake scars on the upper surface. Both edges show over-all indentations.

5. Zehmen. A thick, triangular point of light grey flint, slightly patinated and almost unrolled. It has a large striking-platform of nodular cortex, a prominent cone, and a striking angle of 105°. Both cutting edges display indentations. The right edge has been retouched toward the point.

6. A triangular, pointed flake of light grey flint, slightly patinated and unrolled. It has a very small, plain striking-platform. The left rear corner has been removed. Both edges show fine indentations and retouching.

7. Zehmen. An almond-shaped, pointed flake of translucent, bryozoa-carrying, light grey flint, scarcely patinated, and unrolled. It has a plain striking-platform, a striking angle of 115°, a single main rib on the upper surface, and a few indentations along both edges.

8. Cröbern. A point of light grey flint, heavily patinated and rolled. The striking-platform cannot be recognized. The upper surface shows three flake scars. The rounded edges probably exhibited over-all indentations originally.

9. A blade-point of light grey flint, slightly patinated, and unrolled. It has a very small, plain striking-platform, a striking angle of 105°, and a slight curvature. The upper surface shows several flake scars and is trimmed by stepped flaking toward the rear. Both cutting edges exhibit over-all indentations made partly from above, partly from below.

10. A single-ribbed point of light grey flint, patinated light brown, and rolled. It has a plain striking-platform and a striking angle of 110°. The right rear end has been trimmed by stepped flaking, and the corner struck off. Both edges show indentations.

11. A small, triangular, pointed flake of grey flint, slightly patinated and unrolled. It exhibits no striking-platform. The small but prominent bulb of percussion has been trimmed off. The flake has a slight curvature. The right edge shows indentations made from below; the left, very fine retouching done from above.

12. A large, thick point of mottled, grey flint, unrolled, and with a slightly brownish patina. The striking-platform, which shows a few facets, lies on the left in the rear. The primary blow was probably made with a stone, which produced a long, flat bulb and a striking angle of 90°. The upper surface exhibits a few long blade scars, as well as some nodular cortex toward the right rear. The left cutting edge shows over-all simple retouching, especially on the lower surface; the right one, on the other hand, on the upper surface. The middle section of the right edge and the point, which was probably sharp originally, were broken off in antiquity, probably as the result of use.

13. Cröbern. A single-ribbed point of light grey flint, heavily rolled and patinated. It has a large, plain striking-platform, a cone and thick bulb, and a striking angle of 110°. Both edges have been rolled and show narrow retouching or indentations. This point has been previously illustrated by Braune (1934).

14. A pointed flake-blade of mottled flint, patinated rusty brown, and unrolled. It has a plain striking-platform, a striking angle of 100°, a cone, and a short, flat, but prominent bulb. The upper surface shows a middle rib, which was broken away at the rear as the result of a trimming blow. The left edge exhibits over-all indentations, especially on the lower surface. There are few indentations on the right.

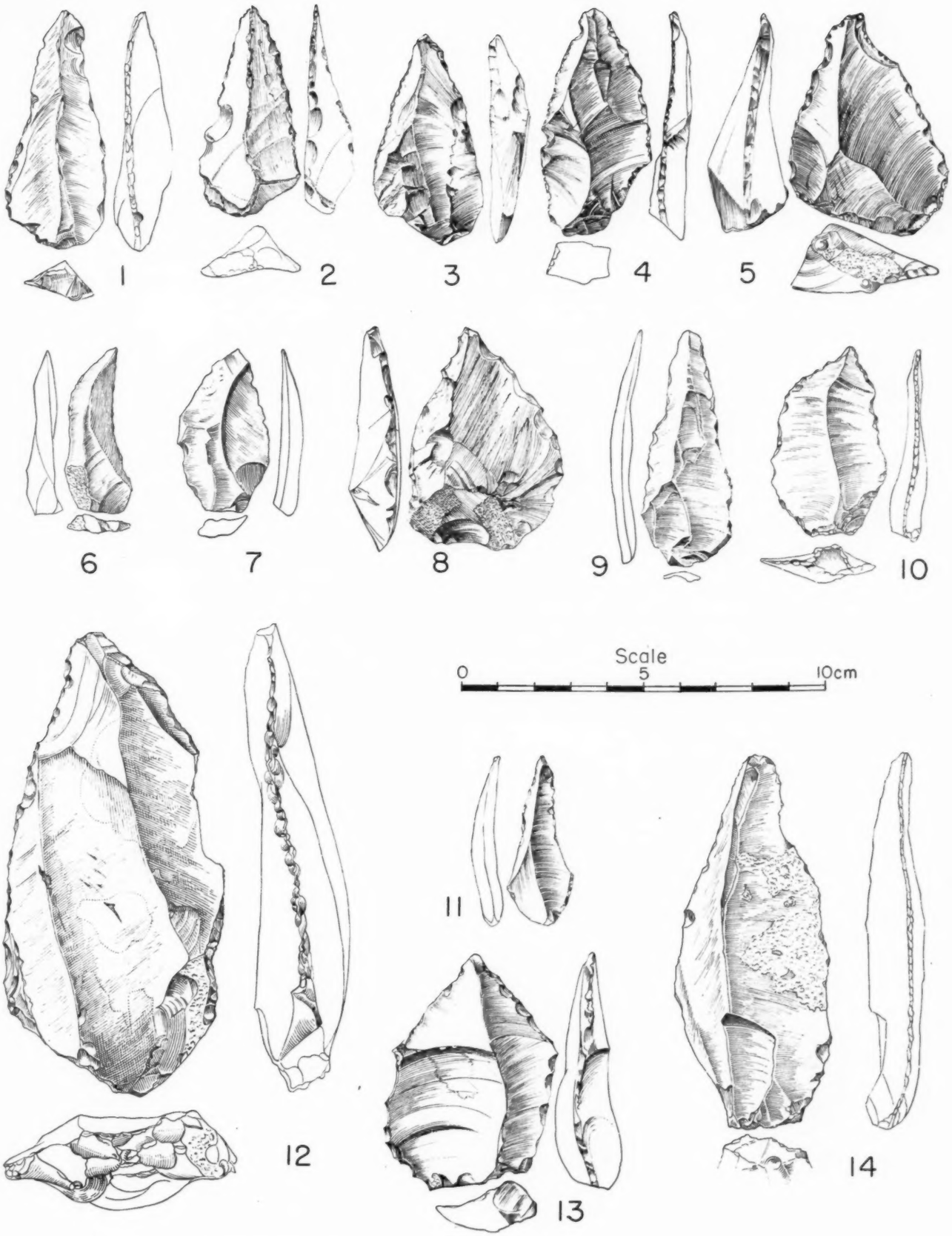


FIG. 53

FIG. 54. Flat points.

1. A point of light grey flint, patinated light brown, and unrolled. It was made by the stone-on-stone technique, has a plain striking-platform, a striking angle of 110°, and a single-ribbed upper surface. The right rear end has been trimmed by additional blows. Both edges show only a few indentations.

2. A thin blade-point of shiny, olive-colored flint, patinated, and slightly rolled. It has a very small striking-platform which lies at a right angle to the long axis. The upper surface has been thinned toward the rear by stepped flaking. Both edges show coarse indentations.

3. A single-ribbed flake with rounded point, of mottled flint, patinated an olive color, and slightly rolled. It has a large, plain striking-platform, two cones of percussion, a prominent bulb, and a striking angle of 110°. The right edge shows indentations made from below; the left, from above.

4. Zehmen. A blade-point of grey flint, patinated an olive color, and slightly rolled. It has a plain striking-platform, a small bulb of percussion, and a striking angle of 100°. The upper surface shows two main ribs which join at the distal end. Both cutting edges exhibit simple over-all retouching.

5. A single-ribbed point of translucent, grey flint, slightly patinated and unrolled. It has a large, plain striking-platform, with a double point of impact, two cones which join in a prominent bulb, and a striking angle of 120°. Both edges show traces of abrasion, as well as indentations made from above and below.

6. A point of translucent, grey flint, slightly patinated and unrolled. It has a large striking-platform with a double point of impact, a cone, and a bulb of percussion which is only slightly developed. There is a striking angle of 105°. The upper surface exhibits two ribs which join toward the distal extremity. The specimen has been trimmed toward the rear. Both cutting edges display fine over-all retouching.

7. Zehmen. A single-ribbed, pointed flake of translucent flint, patinated grey-brown, and unrolled. It has a plain striking-platform, no cone, a small bulb of percussion, and a striking angle of 120°. Both edges exhibit indentations and more recent traces of abrasion. The right edge shows retouching toward the point.

8. A single-ribbed point of grey flint, slightly patinated and unrolled. It has a large, faceted striking-platform at a right angle to the long axis, and a prominent bulb of percussion. The left edge shows some fine indentations.

9. A double-ribbed, pointed flake, patinated olive-brown, and slightly rolled. It has a large, plain striking-platform which lies at a right angle to the long axis. The indentations and retouching along both edges have been rounded by rolling.

10. A blade-point, heavily patinated an ochreous color, and rolled. The striking-platform has been removed by a trimming blow struck toward the upper surface. The left edge exhibits very fine indentations; the right, coarse indentations made partly from above.

11. A single-ribbed point of grey flint, slightly patinated and unrolled. It has a small, plain striking-platform, a short cone, and a heavy bulb. The right rear corner of the specimen has been struck off. The left edge shows over-all indentations and fine retouching; the right, retouching only toward the distal end.

12. A rather thick point of flint, patinated light brown, and slightly rolled. It has a small, plain striking-platform, a well-developed cone and bulb of percussion, and a striking angle of 110°. The upper surface exhibits three flake scars. Both edges show indentations or very fine retouching. The right edge exhibits heavy notching toward the point. This specimen has previously been described by Braune (1928).

13. A small point of flint, patinated brown, and slightly rolled. It has a large, plain striking-platform and a striking angle of 110°. The upper surface exhibits one main rib and has received a trimming blow from the rear. Both cutting edges show indentations.

14. A slightly rolled, pointed flake of translucent, brown flint. It has a small striking-platform, with the bulb of percussion either purposely removed or broken off. Both edges show indentations.

15. A single-ribbed flake with a rounded point, made of variegated grey flint, slightly patinated and rolled. It has a large, plain striking-platform with a prominent cone of percussion, and a striking angle of 115°. Both cutting edges show over-all indentations.

16. A single-ribbed point of translucent, grey flint, slightly patinated, and unrolled. It has a narrow striking-platform, and a striking angle of 100°. The right rear corner has been broken off. The left cutting edge shows indentations made from both surfaces. The right edge has been blunted with very fine retouching.

17. A single-ribbed point of translucent, light grey flint, slightly patinated, and unrolled. It has a narrow striking-platform, a cone of percussion, a bulb, and a striking angle of 120°. The right rear corner has been broken off. Both cutting edges show over-all indentations. The point exhibits fine retouching.

18. Cröbern. A single-ribbed point of light grey flint, slightly patinated, and unrolled. The bulb of percussion and the right rear corner were removed by trimming blows from the rear. Both edges exhibit coarse indentations made from both surfaces, as well as some very fine retouching. This point has been previously illustrated by Braune (1924).

19. Zehmen. A single-ribbed point of translucent, olive-colored flint, rolled, and with a shiny patina. The striking-platform has a few facets, and there is a prominent bulb of percussion, and a striking angle of 100°. Both edges show indentations and more recent projections.

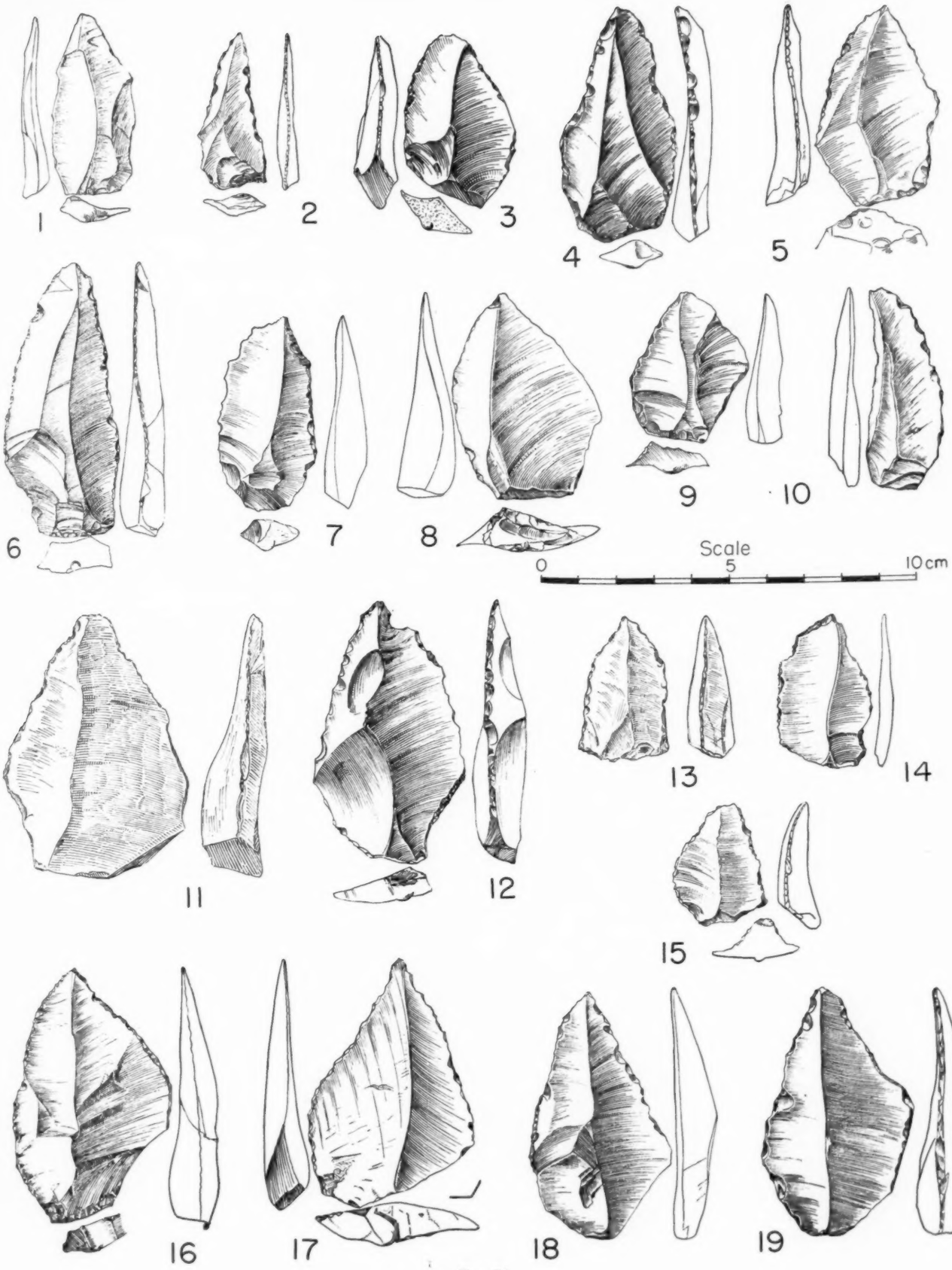


FIG. 54

FIG. 55. Flat points and blade-points.

1. A blade-point of translucent flint, patinated an olive-green color, and unrolled. It was made by the bone billet technique, has a very small striking-platform at a right angle to the long axis, and a slight curvature. The upper surface is primarily single-ribbed. Both cutting edges display some indentations. The point has been sharpened on the right by flaking.

2. A heavy, single-ribbed blade-point of mottled, grey flint, slightly patinated and unrolled. The striking-platform has been removed by blows struck in order to thin down the rear end, and to remove the left rear corner. A small portion of the bulb remains. Both cutting edges show over-all indentations, especially on the upper surface.

3. A single-ribbed point of mottled, light grey flint, dully patinated, and unrolled. It has a large faceted striking-platform, which lies at a right angle to the long axis. The left edge shows fine retouching; the right, over-all indentations, made predominantly from above.

4. A blade-point of mottled, light grey flint, slightly rolled. It was made by the stone-on-stone technique, has a small, faceted striking-platform at a right angle to the long axis, a short cone, and a bulb of percussion. The upper surface is single-ribbed with the rear trimmed by further blows on that surface. Both cutting edges exhibit coarse indentations.

5. A blade-point of translucent, brownish, dark grey flint, slightly patinated, and unrolled. It was made by the bone billet technique, has a plain striking-platform, a striking angle of 110°, and a slight curvature. The upper surface is double-ribbed, thinned toward the rear, and displays nodular cortex toward the left at the distal end. The right cutting edge exhibits fine, over-all retouching.

6. Zehmen. A thick, single-ribbed point of mottled, grey flint, slightly rolled, and with a shiny patina. It has a small striking-platform and was probably made by using an intermediary tool. Both cutting edges show over-all indentations.

7. A single-ribbed point of mottled, grey flint, slightly patinated and unrolled. It has a plain striking-platform, and a striking angle of 100°. The left edge exhibits indentations made especially from below; the right, very fine, over-all indentations, from above.

8. A single-ribbed blade-point of flint, patinated light brown, and unrolled. It has a small, trimmed butt, and a small bulb of percussion. Both cutting edges, particularly the right one, show indentations.

9. A single-ribbed blade-point of mottled, grey flint, partially covered with a rusty patina, and unrolled. The plain striking-platform is narrow. The bulb of percussion is toward the left side of the specimen. The butt end was reduced on the upper surface by a blow from the left. Both cutting edges show over-all indentations.

10. A blade-point of light grey flint, patinated a yellowish color, and unrolled. It was probably made by the stone-on-stone technique, has a plain striking-platform, a poorly developed bulb of percussion, and a striking angle of 110°. The upper surface shows several longitudinal ribs and is thinned by blows from the rear. The cutting edges are almost without indentations. The originally very sharp point was broken off in antiquity.

11. A single-ribbed blade-point of mottled, olive-grey flint, dully patinated, and unrolled. It was made by the bone billet technique, has a plain striking-platform, and a striking angle of 100°. Both cutting edges exhibit indentations, made especially from below. The originally sharp point of the specimen has been recently broken off.

12. A blade-point of grey flint, patinated light brown, and unrolled. It was made by the bone billet technique, has a small, plain striking-platform, and a striking angle of 105°. The upper surface is primarily single-ribbed, with the right rear area thinned by further blows. Both cutting edges show indentations, especially on the lower surface.

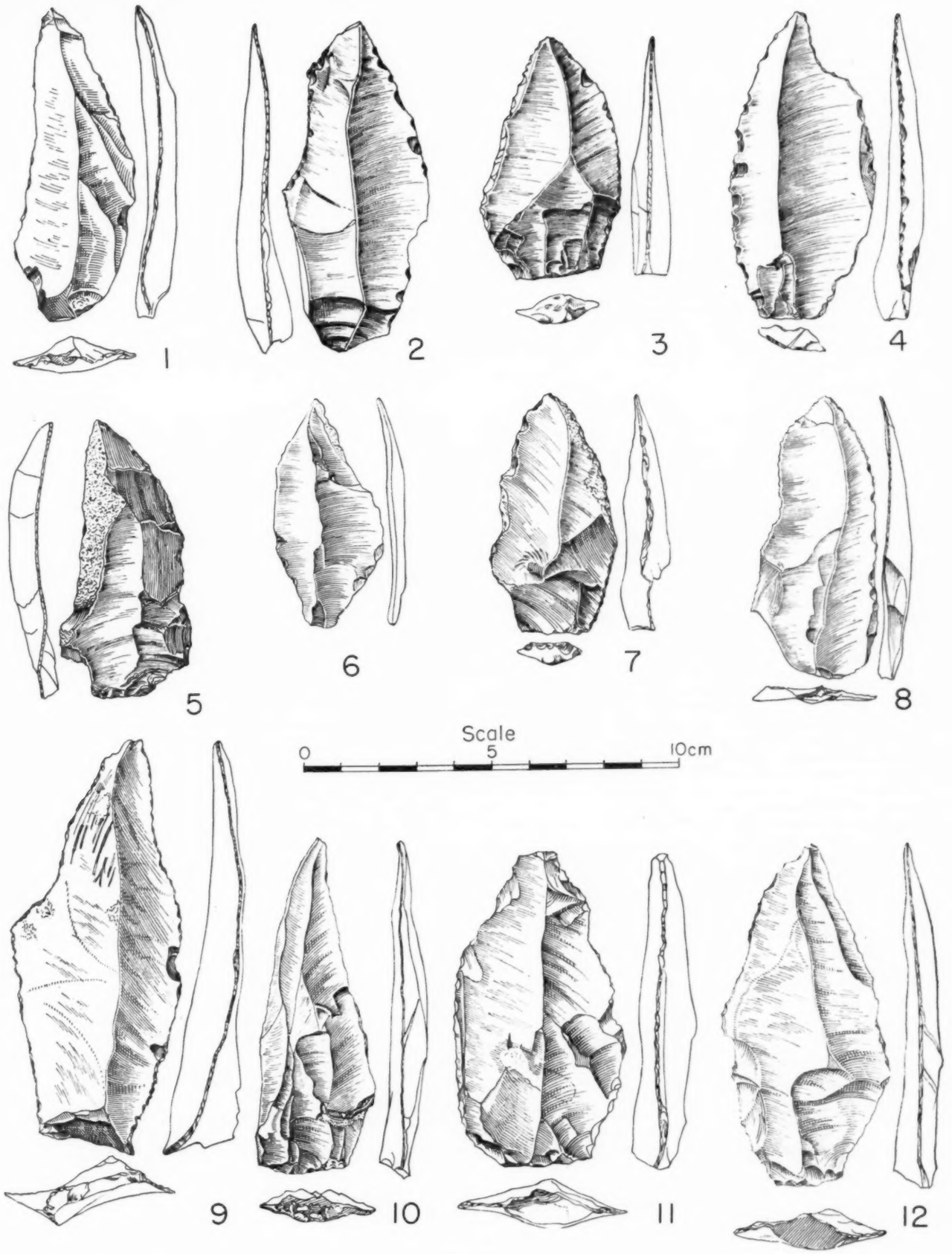


FIG. 55

FIG. 56. Blade-points and Levallois-type triangular points.

1. A blade-point of grey flint, heavily patinated a rusty brown color, and somewhat rolled. It has a faceted striking-platform at a right angle to the long axis. The upper surface is single-ribbed. The right cutting edge displays coarse, over-all indentations made mostly from above. The left edge exhibits fine retouching executed from below.

2. A flat blade-point of translucent, grey-brown and honey-colored flint, slightly patinated, and unrolled. It has a small, plain striking-platform, and a striking angle of 110°. The upper surface exhibits many flake scars. The cutting edges show very fine indentations.

3. Zehmen. A blade-point of translucent flint, patinated brown, and almost unrolled. It has a small, faceted striking-platform at a right angle to the long axis. The upper surface shows a single main rib. Both cutting edges exhibit over-all indentations.

4. A blade-point of mottled, grey flint, slightly patinated, and somewhat rolled. The striking-platform has been removed by thinning blows. The upper surface exhibits one main rib, and an area of cortex toward the right. Both cutting edges show over-all indentations.

5. A triangular point of flint, patinated an olive-brown color, and unrolled. It was made by the bone billet technique, has a narrow striking-platform, and a striking angle of 100°. The upper surface exhibits three flake scars, and is thinned toward the rear. Both cutting edges show indentations made especially from the upper surface.

6. A triangular point of banded, light and dark grey flint, slightly patinated, and unrolled. It has a long, curved, faceted striking-platform at a right angle to the long axis, a projecting cone, and a short, thick bulb of percussion. The upper surface exhibits several flake scars. The distal end of the specimen was broken off in antiquity, probably through use as indicated by the drawing. Both cutting edges show over-all indentations, with some narrow retouching on the lower surface. This specimen may be classified as a *pointe triangulaire*.

7. A triangular point of mottled, grey flint, slightly patinated, and unrolled. It has a narrow, faceted striking-platform at a right angle to the long axis, a prominent bulb, and a slight curvature. The upper surface exhibits two ribs which join at the distal end. Both edges show some indentations. The specimen is a true *pointe triangulaire sans retouche*, as the type appears in the later stages of the French Levalloisian (*cf.* Breuil and Koslowski, 1931–32: fig. 9, no. 3 and fig. 12, no. 2).

8. A flat, pointed Levallois flake of grey flint, patinated a rusty brown, and unrolled. It has a faceted striking-platform at a right angle to the long axis. The upper surface shows several flake scars. The edges exhibit no indentations, but do show traces of recent abrasion.

9. A triangular point of mottled flint, patinated a grey-brown color, and almost unrolled. It was made by the bone billet technique, has a long, faceted striking-platform, a striking angle of 100°, and a prominent bulb. The upper surface is flat and primarily single-ribbed. Both edges are steep and blunt toward the distal end. Originally the specimen may have been longer, and had the edges broken off through use.

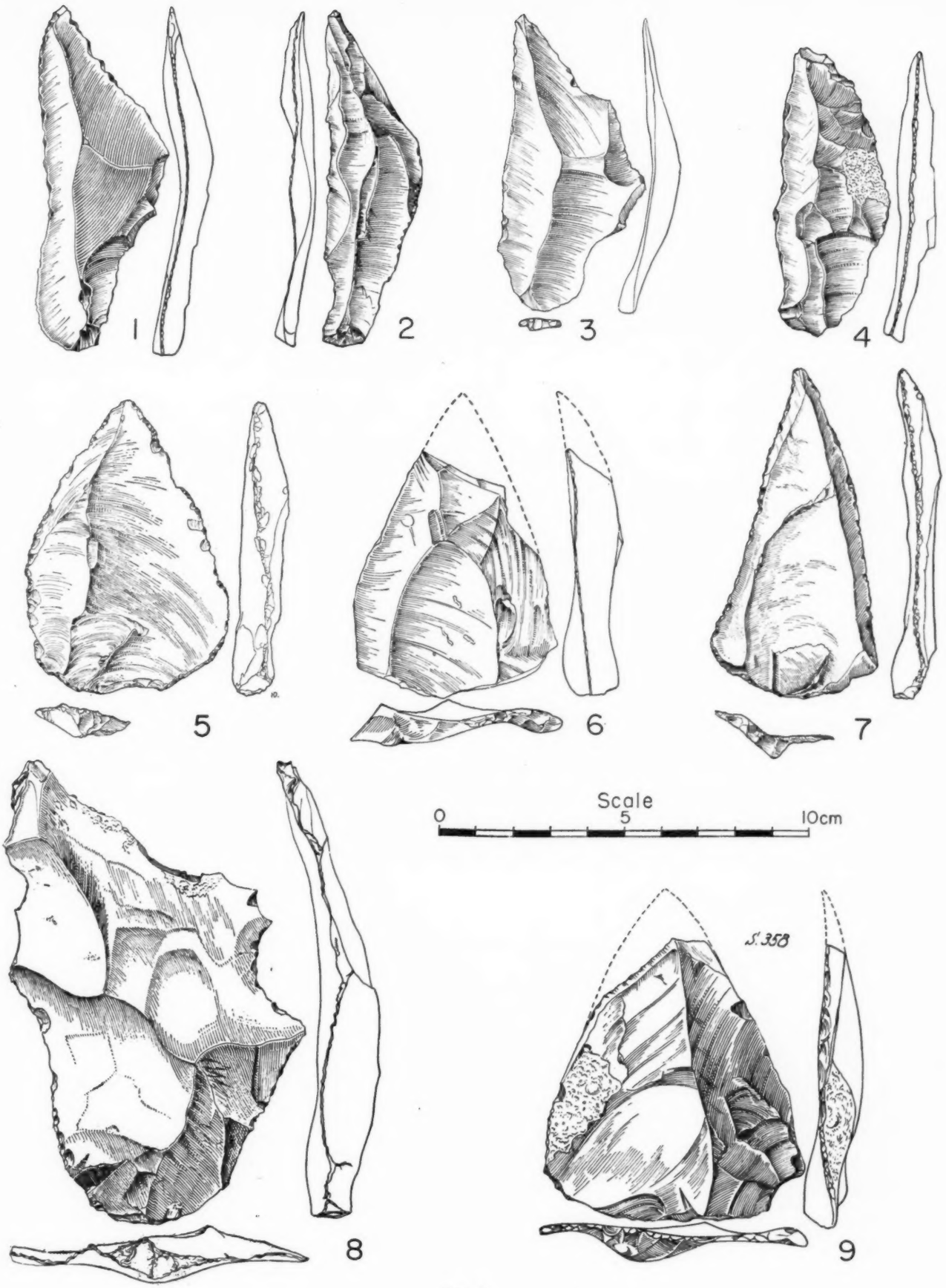


FIG. 56

FIG. 57. Levallois-type points.

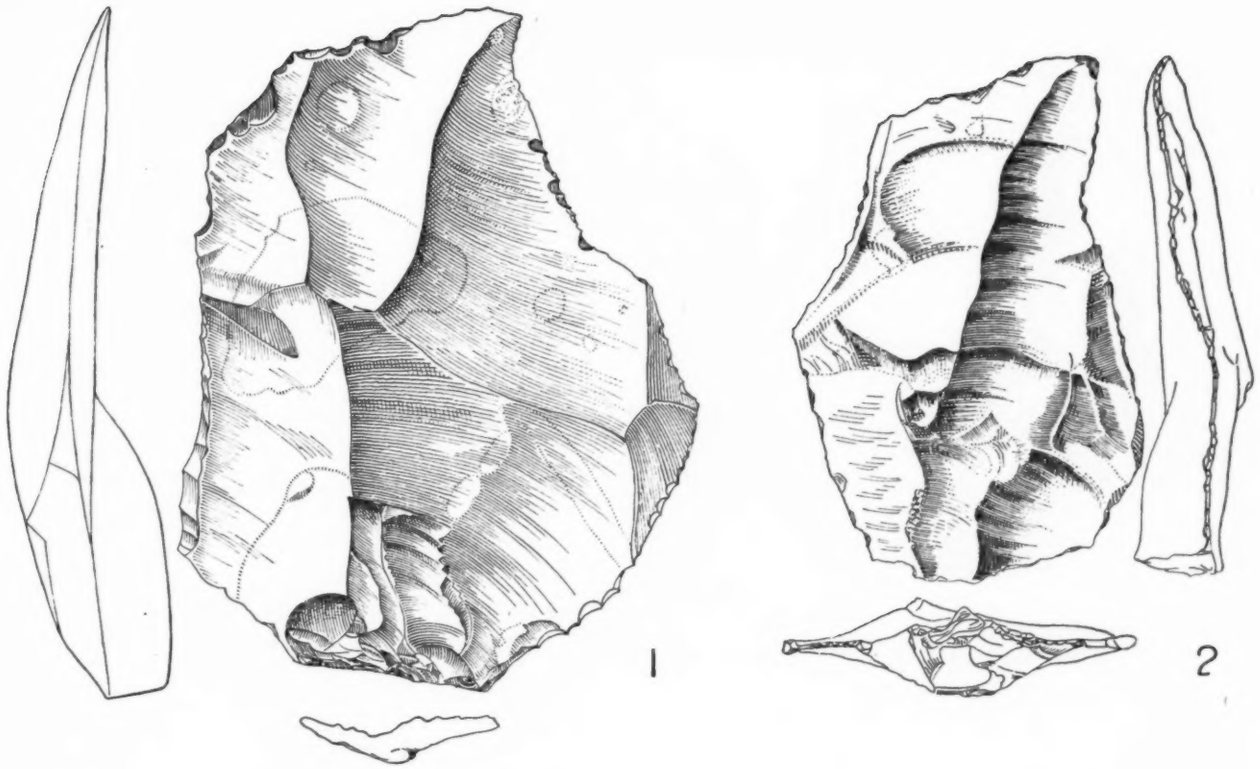
1. A large, pointed Levallois flake of variegated, grey flint, slightly patinated, and unrolled. It was made by the bone billet technique, has a clearly marked incipient point of impact, a small, narrow, plain striking-platform, a strongly projecting bulb (probably due to the structure of the stone), and a striking angle of 100°. The upper surface exhibits several flake scars. The edges show indentations made almost entirely from above, especially along the distal end and right side.

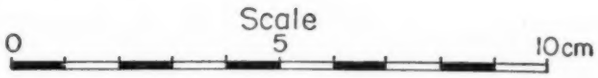
2. A point of partly banded, grey flint, patinated light brown, and almost unrolled. The striking-platform has been crudely prepared, and is at a right angle to the long axis. There is a prominent bulb of percussion, and a slight curvature. The upper surface is primarily single-ribbed. The right edge shows over-all indentations, which continue to the point and are made from below. The left edge shows a few irregular indentations toward the rear.

3. A pointed flake, patinated light brown, and unrolled. It was carefully trimmed on the nucleus prior to detachment, has a plain striking-platform, a short cone, a prominent bulb of percussion, and a striking angle of 110°. The edges show no indentations. The right rear edge has been struck off obliquely. The specimen has also been broken off toward the distal end in the manner of an oblique-ended blade. The original sharp point has been broken off more recently.

4. A faceted flake with a rounded point, patinated light brown, and unrolled. It has a small, faceted striking-platform at a right angle to the long axis. The right rear corner has been obliquely struck off. The distal end of the right edge shows over-all indentations.

5. A point of mottled, grey flint, unrolled, and with a somewhat rusty patina. The striking-platform has a few facets, and the lower surface is strongly rippled, an effect which may be due to the material. The upper surface has been worked partly from the rear and partly from the edge. Both edges show over-all indentations, or simple retouching, executed from above and below. The point on the left is particularly well made.





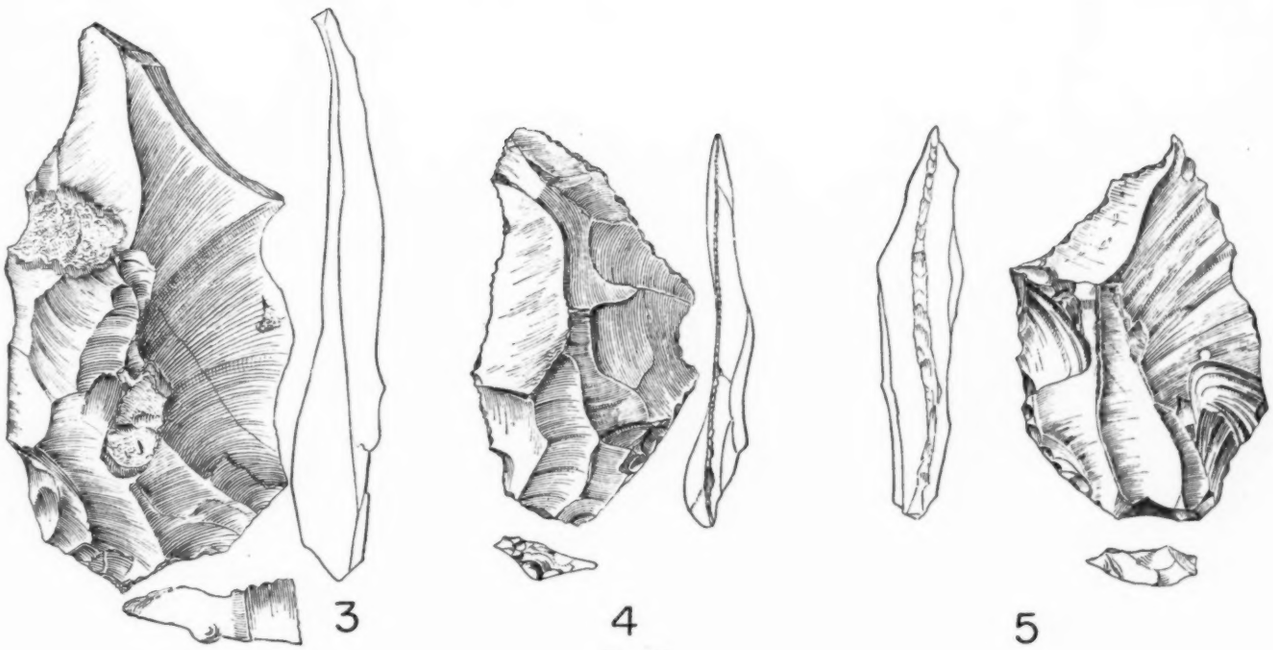


FIG. 57

FIG. 58. Points and Levallois-type points.

1. A broad, pointed flake-blade of black flint, with fresh, sharp edges, and scarcely patinated except for a few areas of rusty-colored stains. It has a large, faceted striking-platform, a striking angle of 115°, and a short prominent bulb of percussion. The upper surface exhibits one main rib which runs into the point. The left cutting edge shows very fine, over-all indentations, mostly on the upper surface. The right edge is blunted and unused except at the distal end, where there are indentations on both surfaces.

2. A Levallois flake of grey flint, with a blunt point, unrolled, and with a partial rusty-colored patina on the upper surface. It has a long, curved faceted striking-platform, a short bulb of percussion, and a striking angle of 110°. The upper surface exhibits several flake scars and is trimmed at the rear. The irregular edges show indentations.

3. A well-prepared, pointed flake of light grey flint, partly patinated a light brown color, and unrolled. It has a very small striking-platform, and almost no indentations along the edges.

4. A pointed flake of grey flint, patinated a brownish-color, and unrolled. It was carefully prepared on the nucleus prior to detachment. The basal end was broken off in antiquity. Both edges show fine indentations made from above and below.

5. A large Levallois flake of grey flint with a blunt point, slightly rolled, and with a patina ranging from brown to porcelainous white. It was made by the bone billet technique, has a large, faceted striking-platform, a striking angle of 110°, and a prominent bulb of percussion. The upper surface exhibits several flake scars, but only one main rib. Both edges show coarse indentations made primarily from above. On the left side these are sometimes serrated. The specimen is similar to the large flakes of the Lower Levalloisian from Montières, near Amiens.

6. A pointed Levallois flake of grey flint, slightly patinated and unrolled. It has a faceted striking-platform at a right angle to the long axis, a short bulb, and a slight *S*-curvature. The left edge has been partly broken off. The right one shows over-all indentations made from above and below.

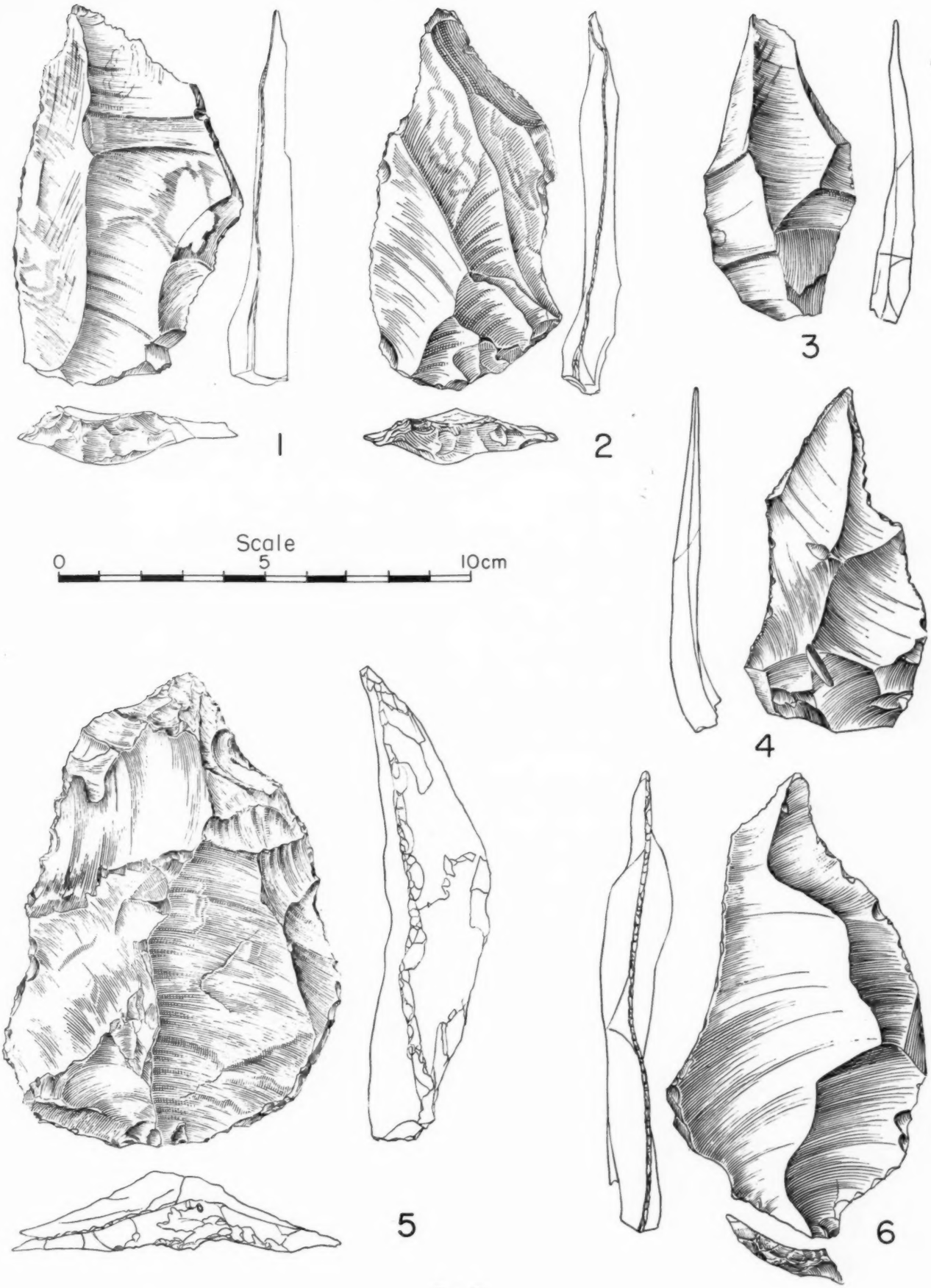


FIG. 58

FIG. 59. Blade-points, and points of miscellaneous type.

1. A blade-point of dull grey flint, patinated a shiny brown, and unrolled. It has a striking-platform with a few facets, which is at a right angle to the long axis, and a short, rather thick bulb. The upper surface exhibits two primary longitudinal ribs and is thinned in the rear by a blow on the butt. The left distal end has received an oblique transverse blow, which makes the specimen intermediate in form between a blade-point and an oblique-ended blade. Both cutting edges show indentations, made from below on the left, and primarily from above on the right. This specimen has previously been described by Jacob-Friesen (1914: pl. 23, fig. 62).

2. A blade-point of dark grey flint, scarcely patinated, and unrolled. It was made by the bone billet technique, has a large, faceted striking-platform at a right angle to the long axis, and a slight *S*-curvature. The upper surface is primarily single-ribbed. The edges exhibit almost no indentations.

3. A blade-point of grey flint, slightly patinated and unrolled. It has a long, faceted striking-platform at a right angle to the long axis, and a thick bulb which was subsequently trimmed. The upper surface exhibits a single rib at the distal end, and a double rib in the rear. Both cutting edges show indentations which are replaced by retouching, especially on the right rear side.

4. A pointed Levallois flake, patinated grey-brown, and unrolled. It has a slightly prepared striking-platform, and a striking angle of 95°. Both cutting edges show indentations. The point curves toward the right, and the tip was broken off in antiquity.

5. Zehmen. A blade-point of extremely fine-grained freshwater quartzite, patinated a rusty-brown color, and rolled. It was made by the bone billet technique, has a plain striking-platform, and a striking angle of 110°. The upper surface shows several longitudinal flake scars. The left cutting edge exhibits over-all indentations or short retouching, and the right shows a few traces of rolling.

6. A double-ribbed, triangular point of grey flint, slightly patinated and unrolled. It has a large, faceted striking-platform, two short striking cones, and a striking angle of 90°. Both cutting edges exhibit fine indentations made from above.

7. A single-ribbed, triangular point of mottled, dark grey flint, slightly patinated and unrolled. It was made by the stone-on-stone technique; the specimen has a large, faceted and curved striking-platform at a right angle to the long axis, and has a thick bulb of percussion. The edges only exhibit a few indentations.

8. A single-ribbed, triangular point of grey flint, slightly patinated and unrolled. It has a large, faceted and curved striking-platform at a right angle to the long axis; there has been no subsequent work on the edges.

9. A point of translucent flint, patinated olive-brown, and unrolled. There is a large, faceted striking-platform in the left rear, which is at a right angle to the long axis. The upper surface exhibits a single main rib, and both edges show a few indentations.

10. A double-ribbed, triangular point of mottled, dark grey flint, almost unpatinated, and unrolled. It was made by the bone billet technique, has a faceted striking-platform, and a striking angle of 105°. The left edge is steep and blunt on the distal end, and retains some white nodular cortex. The right edge exhibits indentations and retouching, especially on the distal end. The point has been sharpened by "graver" blows, especially on the right edge and toward the upper surface.

11. Cröbern. A point of translucent flint, patinated grey-brown, and almost unrolled. It was probably made by using an intermediary tool. The upper surface has been thinned toward the rear. The left edge shows indentations made from below, and retouching toward the point.

12. A blade-point of translucent, grey flint. The specimen is unrolled, and its striking-platform has been broken off. The upper surface is double-ribbed. The edges are not worked, the right one having been broken away in antiquity.

13. Zehmen. A single-ribbed blade-point of translucent flint, patinated light brown and slightly rolled. The striking-platform was broken off in antiquity. Both cutting edges, but especially the right one, exhibit very coarse indentations.

14. An unrolled flint point, patinated brown. The striking-platform has been removed by a thinning blow struck toward the upper surface, which displays two main ribs. There is no working along the edges.

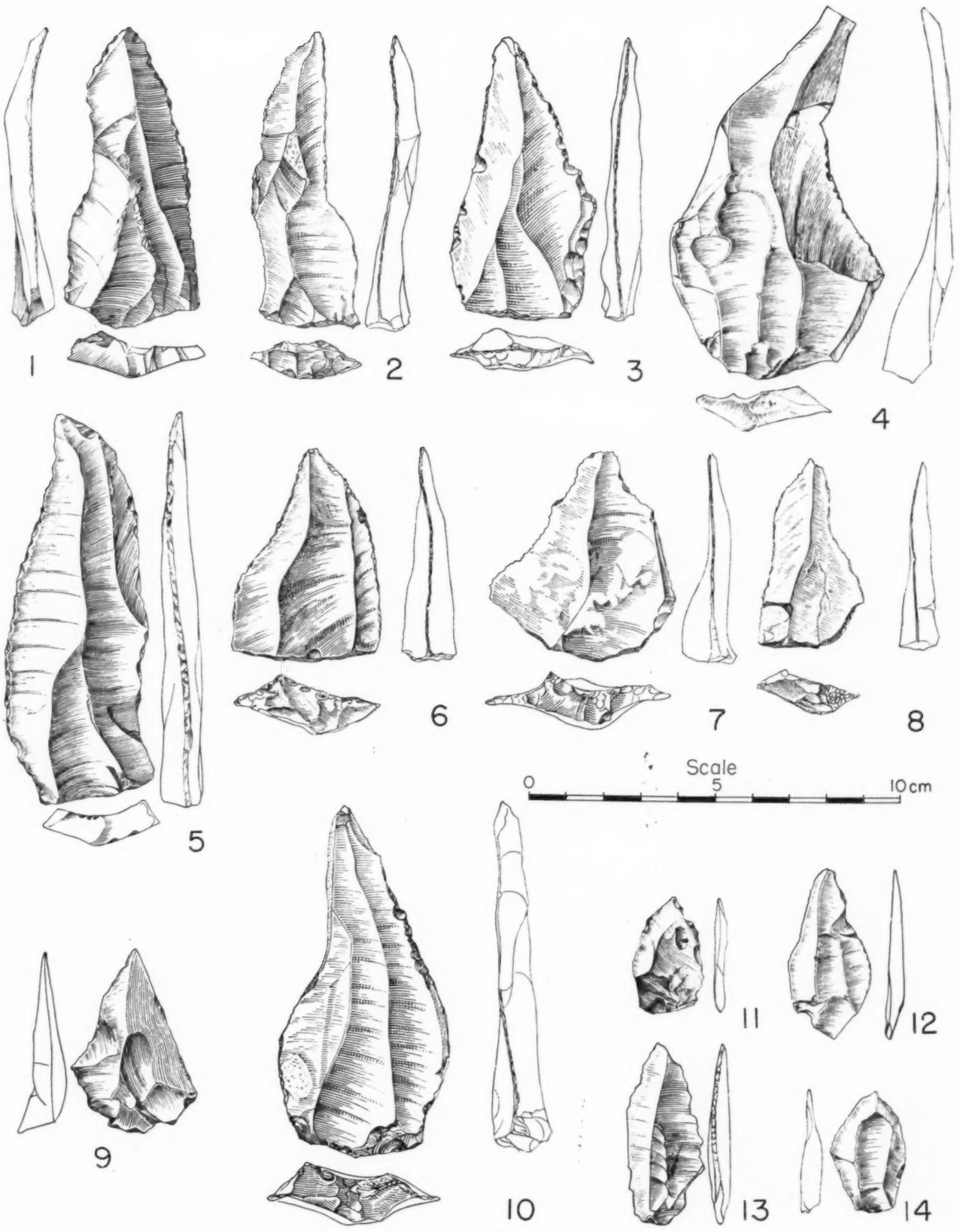


FIG. 59

FIG. 60. Miscellaneous and pentagonal points.

1. A flake with a point located toward the right side, and made of translucent, grey-brown flint. It is unrolled, has a plain striking-platform, and a striking angle of 100°. The upper surface exhibits several flake scars, and has been thinned toward the rear, thus reducing the size of the striking-platform. Both edges show over-all indentations, especially the one on the left.

2. A slightly rolled blade with a rounded point, of translucent, honey-colored flint. It has a plain striking-platform with a prominent cone and bulb of percussion. The upper surface is primarily double-ribbed, and is thinned toward the rear by stepped flaking which reduces the size of the striking-platform almost to nothing. Both edges show over-all indentations made from above and below.

3. A flake of translucent flint with the point located toward the right; it is patinated an olive-brown color, and is unrolled. The striking-platform has been removed by a trimming blow struck toward the upper surface, which exhibits several flake scars. Both edges show over-all indentations made from the lower surface, and a few traces of abrasion on the upper.

4. A pointed flake of grey flint, scarcely patinated, and unrolled. The large, plain striking-platform lies in the rear on the right. There is a striking angle of 115°, and an upper surface which exhibits several flake scars. The right edge shows some indentations made from above.

5. A flat, pentagonal or septagonal flake or grey flint, slightly patinated and unrolled. It has a broad striking-platform with several facets, a striking angle of 110°, and many flake scars on the upper surface. The indentations along the cutting edges, especially on the right, are mostly made from above.

6. A single-ribbed, septagonal-shaped, pointed flake of bryozoa-carrying, grey flint, slightly patinated and unrolled. It has a large, plain striking-platform, with two incipient points of impact. The prominent bulb has been removed by a blow from a bone billet. The striking angle is 105°. Both edges show indentations, made particularly from above.

7. A pointed flake of flint, patinated light brown, and almost unrolled. The rear portion of the specimen has been rounded and thinned by blows struck from the upper surface, a process which has removed the striking-platform. The upper surface exhibits one main rib. The right edge shows indentations made from below. The left edge has been broken off toward the point in antiquity, probably on purpose, in the manner of an oblique-ended blade.

8. A single-ribbed, pentagonal-shaped point of bryozoa-carrying, grey flint, heavily patinated a light brown, and almost unrolled. It was made by the stone-on-stone technique, has a large, plain striking-platform, and a striking angle of 110°. There are some indentations along the edges, made mostly from above.

9. A single-ribbed, pentagonal-shaped point of variegated, dark grey flint, unrolled, and with a somewhat rusty patina. It has a plain, narrow striking-platform, and a striking angle of 110°. Both cutting edges show indentations: on the left made from both surfaces; on the right, from above.

10. A pentagonal-shaped point of translucent, grey flint, slightly patinated and unrolled. It was made by the stone-on-stone technique, has a large striking-platform with a few facets, and a striking angle of 115°. The upper surface displays three primary flake scars. All of the cutting edges exhibit indentations and fine retouching. The latter has been especially well executed on the distal ends of the left and right edges.

11. A pentagonal-shaped point of light grey flint, patinated an ochreous yellow, and unrolled. It was made by the bone billet technique, has a small, plain striking-platform, a striking angle of 100°, and a prominent bulb of percussion. The upper surface exhibits several flake scars. The edges are without indentations, and the distal end of the left edge is steep and blunt. The point is rounded.

12. A pentagonal-shaped point of light grey flint, scarcely patinated and unrolled. It has a plain striking-platform (with several points of impact), a projecting cone, a thick bulb of percussion, and a striking angle of 120°. The upper surface exhibits two longitudinal ribs, which join at the point. The left edge shows very few indentations. The right edge shows indentations toward the distal end, probably made in order to sharpen the point.

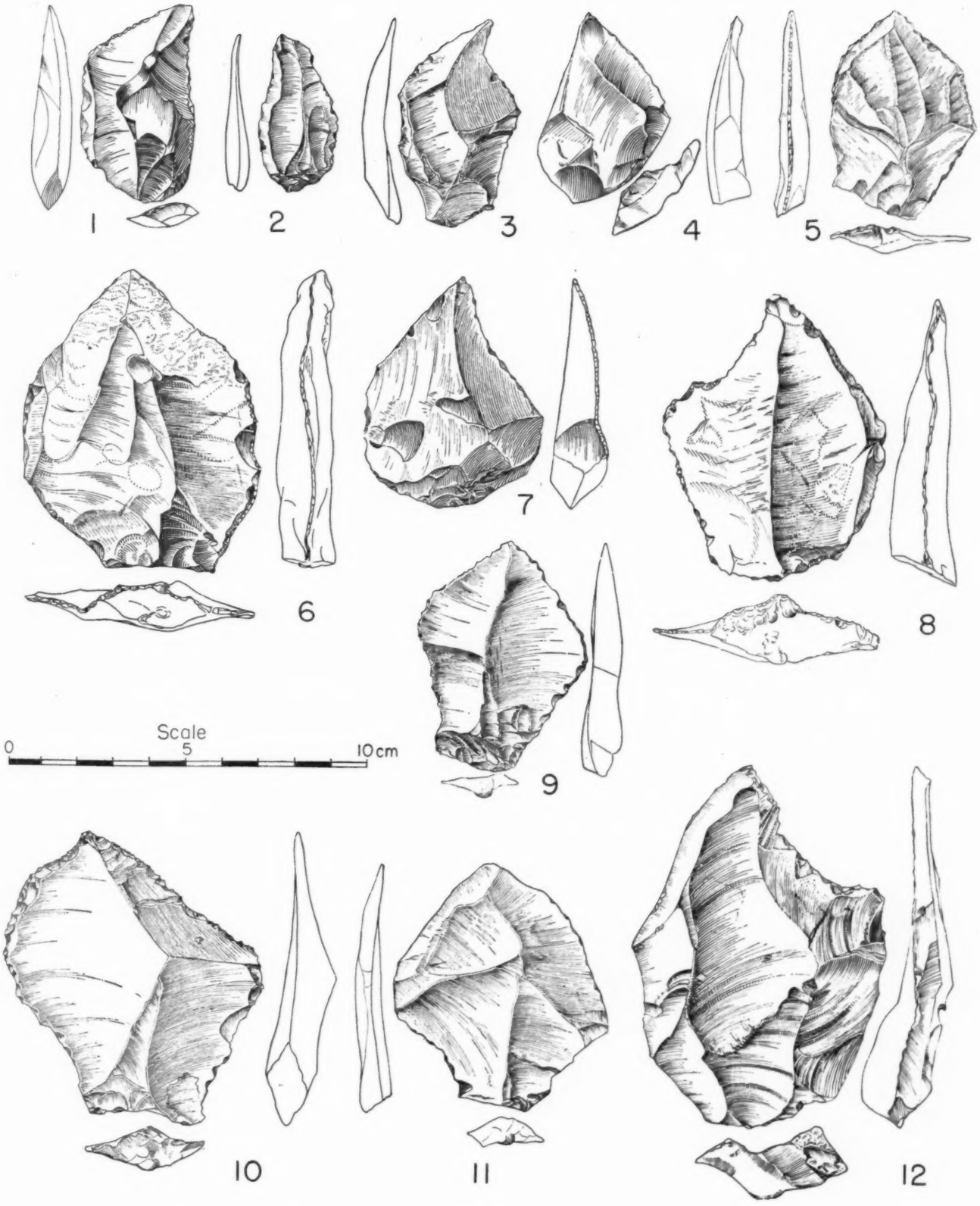


FIG. 60

FIG. 61. Retouched points and points with side-indentation.

1. A point with side-indentations, of light grey flint, only slightly patinated, and unrolled. It was made by the stone-on-stone technique, has a narrow, plain striking-platform, a striking angle of 115°, a prominent bulb, and intersecting percussion ripples. The flat upper surface shows one rib, which forks toward the rear, the result of trimming blows. The sides display several indentations. One of these on the left edge is a purposeful side-indentation on the upper surface, exactly opposite a second one on the left. These may have served as supports for straps or cords in attaching a handle.

2. A pentagonal-shaped point of grey flint, slightly patinated and unrolled. The point retains some cortex. It was made by the stone-on-stone technique, has a plain striking-platform, and a striking angle of 105°. The upper surface shows one main rib, which has been removed in the rear by step-flaking. The edges are unworked, and the point is rounded.

3. A point of variegated grey flint, slightly rolled, and patinated a grey-brown color. The striking-platform shows a few facets, and lies at a right angle to the long axis. The upper surface exhibits two to three ribs. The left edge is retouched along its entire length; the right, only at the distal end.

4. A point of light grey flint, rolled, and only slightly patinated. It was made by the stone-on-stone technique, has a long, extended, plain striking-platform, a striking angle of 100°, and a cone and bulb of percussion. The upper surface has one rib running from the point toward the right rear. The right edge shows a series of indentations along the upper surface. The left edge is blunt with some nodular cortex, except toward the point where it is sharp; it exhibits a prepared side-indentation in the center worked from the lower surface.

5. A point of translucent, grey flint, patinated olive-brown, and unrolled. It has a plain striking-platform, a thick, prominent cone and bulb, and a striking angle of 110°. The upper surface is single-ribbed. Both cutting edges exhibit careful consecutive retouching, which ends at the distal extremity in a sharp point. The upper surface of the butt end exhibits some step-flaking. This specimen has previously been described by Grahmann (1935).

6. A point of grey flint, patinated olive-brown, and unrolled. It was made by the bone billet technique, has a plain striking-platform, a slight *S*-curvature on the lower surface, and a flat upper surface. The left cutting edge exhibits careful, over-all retouching, with a flake in the middle that has been removed at a later date. The right edge is completely blunt, probably on purpose, for the right corner is broken off, and the distal end of the edge clearly shows the traces of a "graver" blow struck from the point. The point itself shows further small "graver" flake scars. Since the left cutting edge exhibits over-all retouching along both surfaces, and since the point was doubtlessly prepared, the specimen apparently served as a point. The blunt right edge, which is particularly adapted for the support of the index finger, makes the specimen equally well suited for use as a knife.

7. A single-edged point of mottled, grey flint, slightly patinated light brown, and unrolled. The stone-on-stone blow was struck on the rolled cortex of a flint nodule toward the center. The upper surface was prepared from both the rear and distal ends. The main middle rib is joined by a secondary rib running toward the right and broadest part of the upper surface, thus reinforcing the object. The left edge has been broken away owing to a hollow spot in the flint. The left cutting edge shows indentations made mostly from above. On the other hand, the right exhibits carefully executed, consecutive retouching. A flake has been removed from the left rear at a later date.

8. A point of grey flint, patinated light brown, and unrolled. It has a plain striking-platform, a very prominent cone and bulb of percussion, and a striking angle of 120°. The upper surface exhibits one main rib, which has been removed toward the rear by step-flaking. Both edges show careful stepped retouching, which ends at the distal extremity in a point. This beautiful specimen was originally described by Jacob-Friesen (1914: fig. 69). This classic piece has often been reproduced and represented as typical for the site of Markkleeberg. In its perfection, however, it is unique at this locality.

9. A point of grey flint, slightly patinated and unrolled, with a rusty-colored lower surface. It was made by the bone billet technique, has a faceted striking-platform, and a striking angle of 85°. This is a blade-point exhibiting over-all, rather steep retouching of both longitudinal edges. The point has been previously described by Grahmann (1935).

10. A point of grey flint, unrolled, and with an olive-colored patina. It was made by the stone-on-stone technique, has a plain striking-platform, a thick cone, long bulb of percussion, and a striking angle of 115°. The upper surface is double-ribbed. Both cutting edges exhibit coarse, stepped retouching. The point is blunt. The upper surface has been thinned across the butt end by step-flaking (*lamellar retouch*).

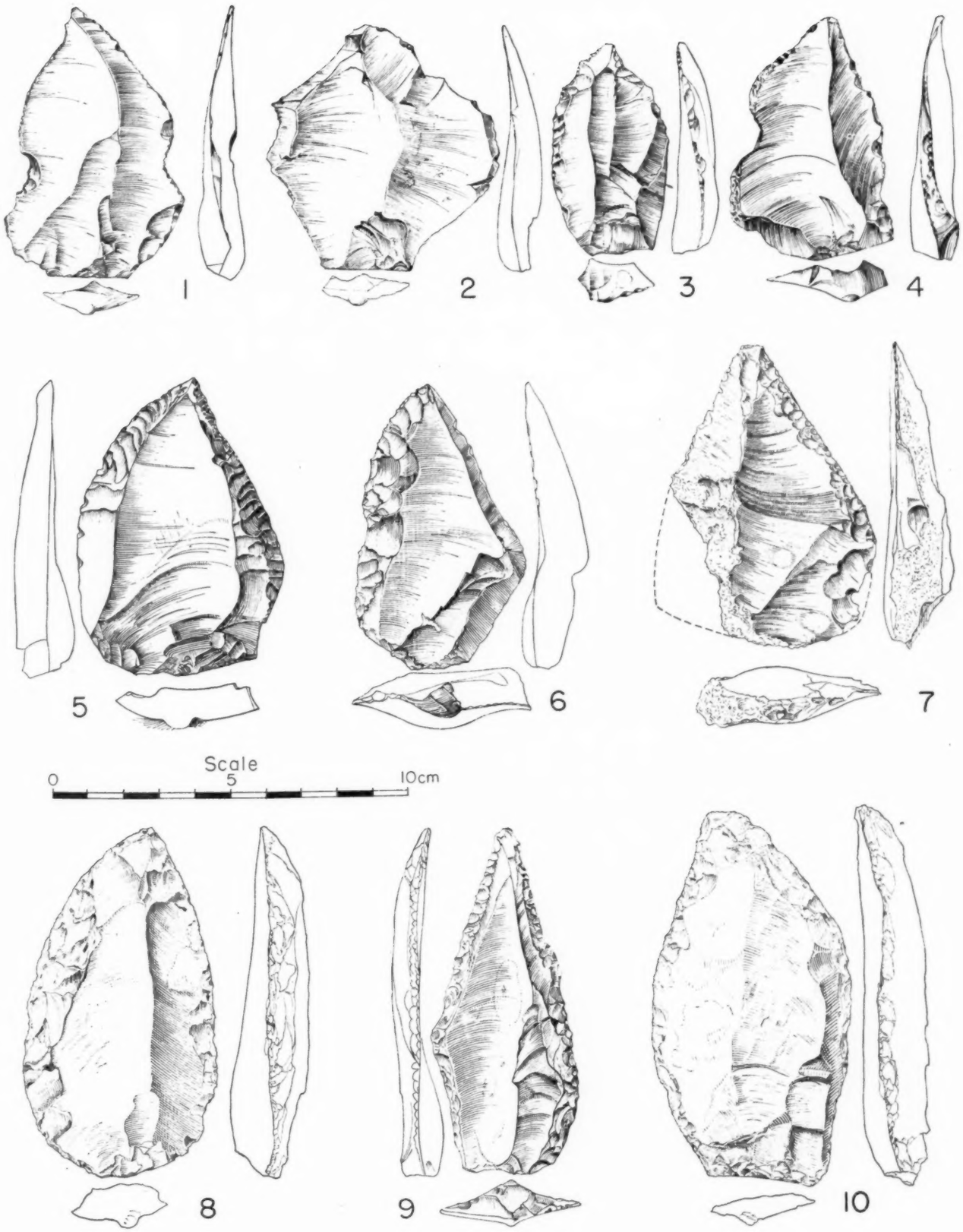


FIG. 61

FIG. 62. Retouched points.

1. A leaf-shaped point of grey flint, slightly patinated, and unrolled. The striking-platform is on the left rear. The lower surface is completely covered by the bulb of percussion. The upper surface shows many flake scars. Both edges exhibit simple retouching at their distal ends, and one of the edges also exhibits comparable retouch on its lower surface.

2. Zehmen. A partially tanged point of grey flint, patinated ochreous brown, and somewhat rolled. The striking-platform is missing from the specimen, which has been made from either a flake or a natural fragment whose strongly curved cleavage plan forms the lower surface. The upper surface is single-ribbed, and the edges exhibit simple retouching. The left edge especially exhibits a concavity, similar to those of scrapers, probably made as an aid in hafting. In addition, the specimen has been trimmed through the removal of the main rib on the upper surface along the tang.

3. A small point of banded, grey flint, patinated brown, and almost unrolled. The striking-platform is on the left rear of the specimen. The bulb of percussion is only weakly developed. The upper surface exhibits long flake scars. The left edge has been retouched, and the point is rounded.

4. A point of grey flint, slightly rolled. The striking-platform is missing. The left edge displays simple retouching as far as the point.

5. A small point of light grey flint, patinated and slightly rolled. It has been made from a thick, triangular flake with a small striking-platform and a flat bulb. The upper surface is single-ribbed with some cortex on the right; it has been retouched on the left, as well as along the left edge. The retouching has been carefully executed toward the awl-like point.

6. Leipzig-Wahren. A leaf-shaped point of light grey flint, slightly patinated and rolled. The specimen has been made from a flake, the striking-platform of which has been removed by retouching of the edges and lower surface. The retouch is especially careful on the distal end of the right edge. On the other hand, the retouch on the left is simple. Points of this type, which are intermediate in form between the present series and bifaces, appear as early as the Lower Acheulian. This specimen has previously been described by K. Braune (in Frenzel, Radig, and Reche, 1934; see also Grahmann, 1935).

7. A small point of black flint, slightly patinated and rolled. It has been made from a triangular flake, the striking-platform of which has been removed as the result of surface retouching, probably done to aid in hafting. The edges are steep, and exhibit over-all simple retouching.

8. A thick point, patinated dark brown, and unrolled. It has a large, unfaceted striking-platform, a short cone and bulb, and a striking angle of 120°. The upper surface is single-ribbed. Both cutting edges exhibit simple retouching. The distal end of the left edge was broken away in antiquity. This point has previously been described by Jacob-Friesen (1914: fig. 68).

9. A thick, retouched point of grey flint, patinated light brown, and unrolled. It has a large, plain striking-platform with a double point of impact, a projecting cone, prominent bulb, and a striking angle of 110°. The upper face shows careful surface and edge retouching, especially on the right. The specimen is similar to the points found at Warren Hill and High Lodge, east of Cambridge (England), which are classified as advanced Clactonian.

10. A partially tanged point of grey-black flint, slightly patinated and rolled. It has been made from a triangular flake-blade with a small striking-platform and a flat bulb of percussion. The upper surface is marked by a sharp main rib. The right edge shows primary, and the left, secondary flaking, as a result of which the point was formed and sharpened. The left edge has been blunted by a blow struck from the rear toward the middle resulting in a partial tang. At the distal end the left edge is sharp. The right edge exhibits over-all indentations toward the rear.

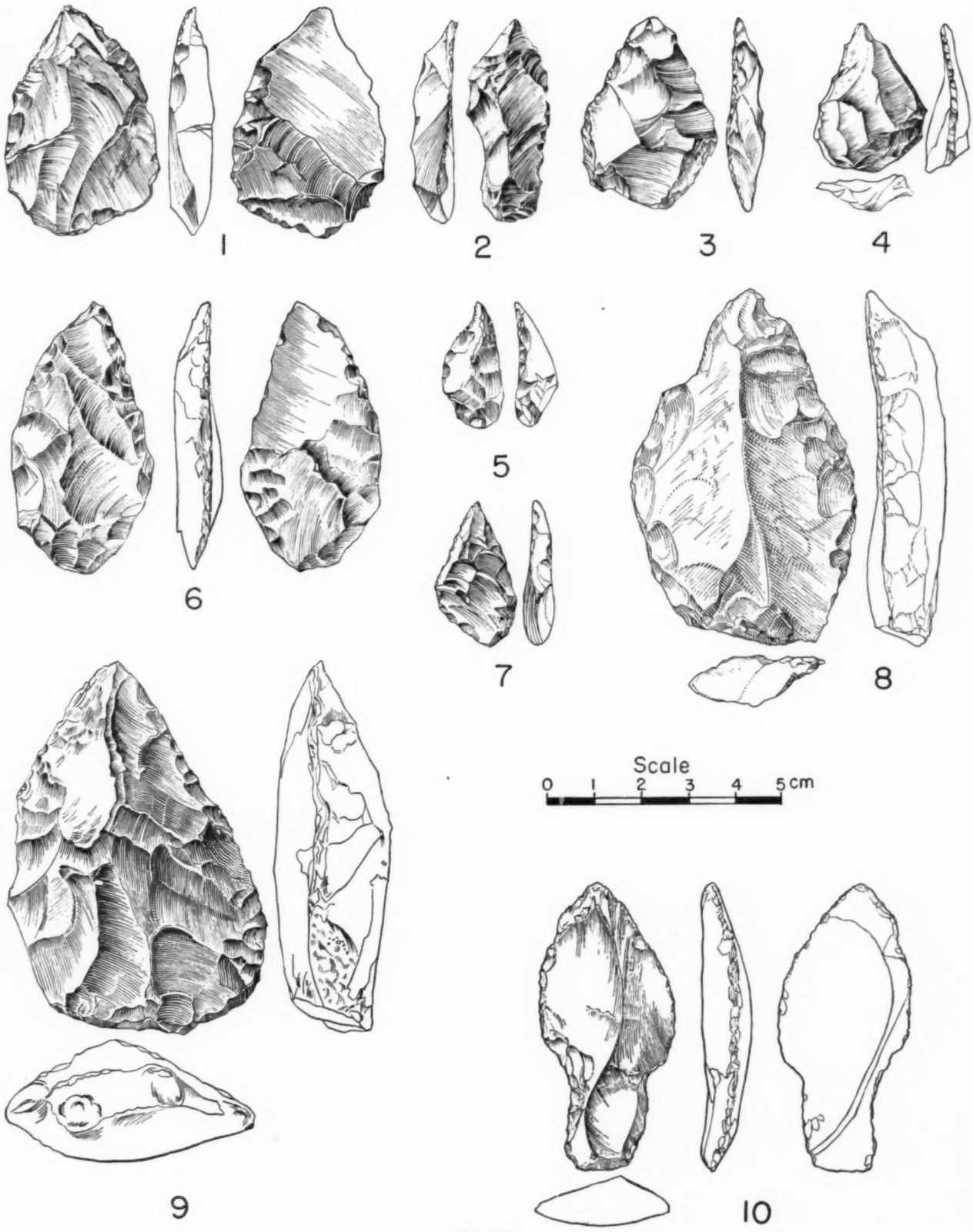


FIG. 62

FIG. 63. Side-scrapers.

1. A side-scraper with several edges, patinated grey-brown, and unrolled. It has been made from a natural fragment. The upper surface has been worked by the removal of thin flakes, and three edges have been sharpened from the lower surface. The point may have been formed on purpose. All blows were heavy. This specimen has previously been described by Jacob-Friesen (1914: fig. 57).

2. A side-scraper of grey flint, slightly patinated and unrolled. It has been made from a flake or a natural fragment. The upper surface shows a few flake scars. The lower surface of one edge has been retouched in a rather simple fashion.

3. A broad-blade side-scraper of slightly mottled, grey flint, lightly rolled, and patinated an olive color. It was made by the stone-on-stone technique, has a large, broad, plain striking-platform, a striking angle of 110°, a short cone, and a thick bulb. The point of impact ends in a round fracture. The upper surface shows two ribs which run toward the distal end. The left edge exhibits very coarse, simple retouching. The right one shows careful stepped retouching.

4. A side-scraper of olive-colored flint, slightly patinated, and unrolled. It has been made from a large flake or perhaps, more probably, from a natural fragment. The surface has been worked by the removal of a few long flakes. There is some retouching on the curved edge. On the lower surface the edges have been sharpened by retouching.

5. A right-sided, straight-edged, side-scraper of unrolled, olive-grey flint. It was made from a round nodular flake (produced with a hammerstone and anvil), has a distinct cone and bulb, and a striking angle of 120°. The nodular cortex on the left side displays glacial striations. The right side of the specimen has been removed by a blow delivered from the striking-platform. The edge then received short retouching. Thus, a crescent-shaped side-scraper with a straight working edge was produced.

6. A right-sided side-scraper made on a flint blade, slightly patinated, and unrolled. It was made by the stone-on-stone technique, has a prepared striking-platform, a cone, and a prominent bulb of percussion. The upper surface shows one main rib. The left edge exhibits indentations; the right, overall, careless retouching.

7. A left-sided, straight-edged, side-scraper of unrolled, variegated grey-black flint. It was made from a round, cortical flake with a prominent cone and bulb, and a striking angle of 120°. The original, large striking-platform has been reduced in size by a blow in the rear aimed at the upper surface. The left half of the specimen has been trimmed into a straight-edged side-scraper, which has been retouched in a rather coarse manner. Thus, a crescent-shape with a straight edge was produced. Part of the cortex may still be seen on the upper surface.

8. A side-scraper made on a broad blade of grey flint, patinated an olive color, and unrolled. It was made by the bone billet technique, has a faceted striking-platform, and a striking angle of 100°. The upper surface exhibits two flake scars, and some nodular cortex on the right. The right cutting edge was apparently never used. The left one shows carefully executed stepped retouching, especially toward the distal extremity.

9. A right-curved side-scraper of dark grey flint, rolled, and slightly patinated. It has a large, plain striking-platform at a right angle to the long axis, and a prominent, projecting bulb. The upper surface exhibits simple flaking, and some nodular cortex on the left. The right edge shows stepped retouching on both the upper and lower surfaces. The distal end of the specimen has been broken off in antiquity.

10. A side-scraper made on a broad flint blade, patinated yellow-brown, and unrolled. It was made by the bone billet technique, has a plain striking-platform, and a rounded distal extremity. The left edge shows indentations made mostly from above. The distal portion of the right edge exhibits stepped retouching.

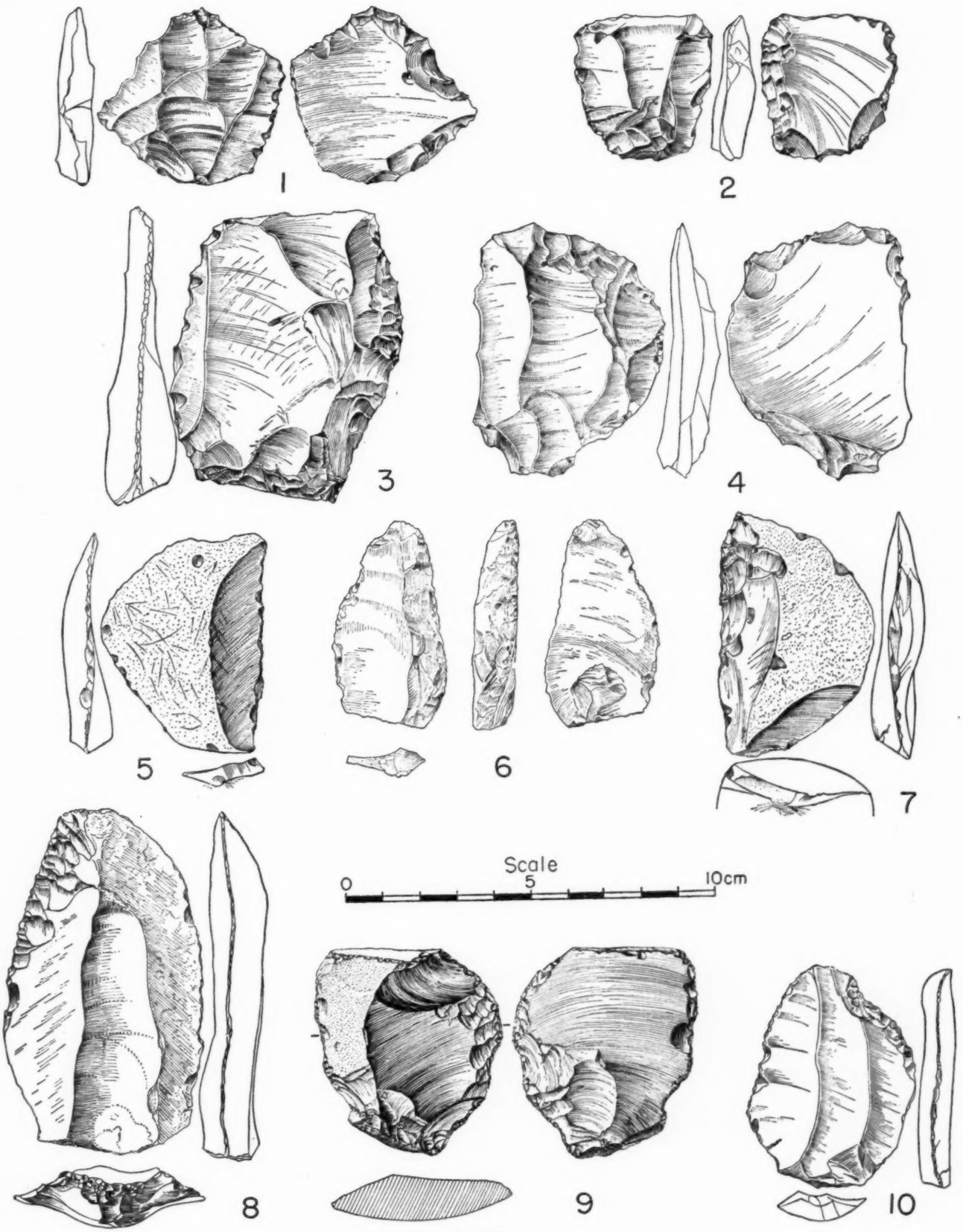


FIG. 63

FIG. 64. Side-scrapers.

1. An almond-shaped side-scraper of translucent, honey-colored flint, rolled, and heavily patinated. This very flat specimen has been made from a flake. It was produced by the stone-on-stone technique, and has a large faceted striking-platform at a right angle to the long axis. The upper surface is a single plane (illustrated on the right in the figure). The edges are all retouched, most carefully on the right.

2. A side-scraper of translucent, honey-colored flint, slightly patinated, and unrolled. The specimen has been made from a flake. The striking-platform and part of the bulb of percussion have been removed by blows struck toward the lower surface. The upper surface shows several flake scars, and has been trimmed toward the rear. The left edge exhibits fine indentations, as does the lower surface of the distal extremity. The right side displays simple, but careful retouching.

3. A side-scraper made on a round flake of unrolled, variegated, grey flint. The very thick bulb of percussion has been removed, causing the formation of a deep shell-like projection 5 cm. in diameter on the lower surface. On the upper surface, opposite the projection, there is another one to the left in the rear. Thus supports for the fingers or for hafting were produced. The other scars on the upper surface were made prior to the detachment of the flake from the core. The left edge has been sharpened by shallow, stepped retouching.

4. A left-sided side-scraper made on a blade of grey flint, patinated light brown, and rolled. It has a very small platform at a right angle to the long axis, and a short bulb. The upper surface is very flat. The right edge is steep and blunt along most of its length. On the other hand, the left one exhibits stepped retouching along its convex contour.

5. A left-sided side-scraper made on a blade of translucent, honey-colored flint, slightly rolled and patinated. The striking-platform is missing, but the lower surface exhibits percussion ripples. The upper surface shows a prominent rib, and some cortex along the distal part of the right edge. The right edge displays indentations toward the rear, especially along the lower surface. The left edge exhibits rather steep stepped retouching.

6. A side-scraper of dark grey flint, slightly rolled and patinated brown. The striking-platform is missing, but the lower surface exhibits percussion ripples. The left rear part of the specimen was broken off in antiquity. The curved upper surface still shows part of the nodular cortex. The right edge exhibits stepped retouching.

7. A side-scraper of dark grey flint, slightly patinated, and unrolled. There are no marks of artificial percussion; hence it is possible that the specimen is a natural fragment. The curved upper surface consists mainly of nodular cortex. The right edge shows coarse indentations made from above and below. The left edge has been retouched steeply at the distal end into a slightly concave scraper. This edge towards the rear is convex and exhibits coarse retouching.

8. A right-sided side-scraper made on a blade of unrolled, translucent, grey flint. The lower surface is almost unpatinated. The upper surface shows traces of an incipient white patina. It has a large striking-platform with a few facets, and apparently a prominent bulb of percussion which has been trimmed. The upper surface exhibits several flake scars. The left edge shows indentations, especially on the upper surface. The convex right edge shows careful stepped retouching, especially on the upper surface. The distal end, however, exhibits retouching on both surfaces. The specimen is intermediate in form between a side-scraper and a retouched point.

9. A right-sided, curved side-scraper of black flint, scarcely patinated, and unrolled. It is a cortical flake struck off by the stone-on-stone technique, and the left edge has been trimmed by stepped retouching to form fine serrations. The other edge shows over-all indentations.

10. A right-sided, curved side-scraper of dark grey flint, patinated brown and unrolled. It has a retouched striking-platform, which lies at a right angle to the long axis. The right edge exhibits very regular stepped retouching. The left edge shows a few indentations.

11. Cröbern. A side-scraper made on a blade of grey flint, slightly rolled, and patinated a rusty brown color. It has a faceted striking-platform, which lies at a right angle to the long axis, and a large projection. The upper surface is very flat. The right edge shows a few indentations. The transverse cutting edge exhibits simple retouching executed from above, which becomes more careful and extensive toward the left edge. This specimen has previously been described by Braune (1934).

12. A right-sided, curved side-scraper of mottled, grey and milky-white flint, slightly rolled and patinated. The striking-platform and part of the bulb of percussion have been removed by blows struck toward the upper surface. This latter surface shows two main ribs which run toward the distal extremity. This end of the surface also exhibits an area of rolled nodular cortex. The left edge shows steep retouching, which forms a large indentation toward the distal end and a smaller one to the rear. The right edge has less steep, over-all, full retouching.

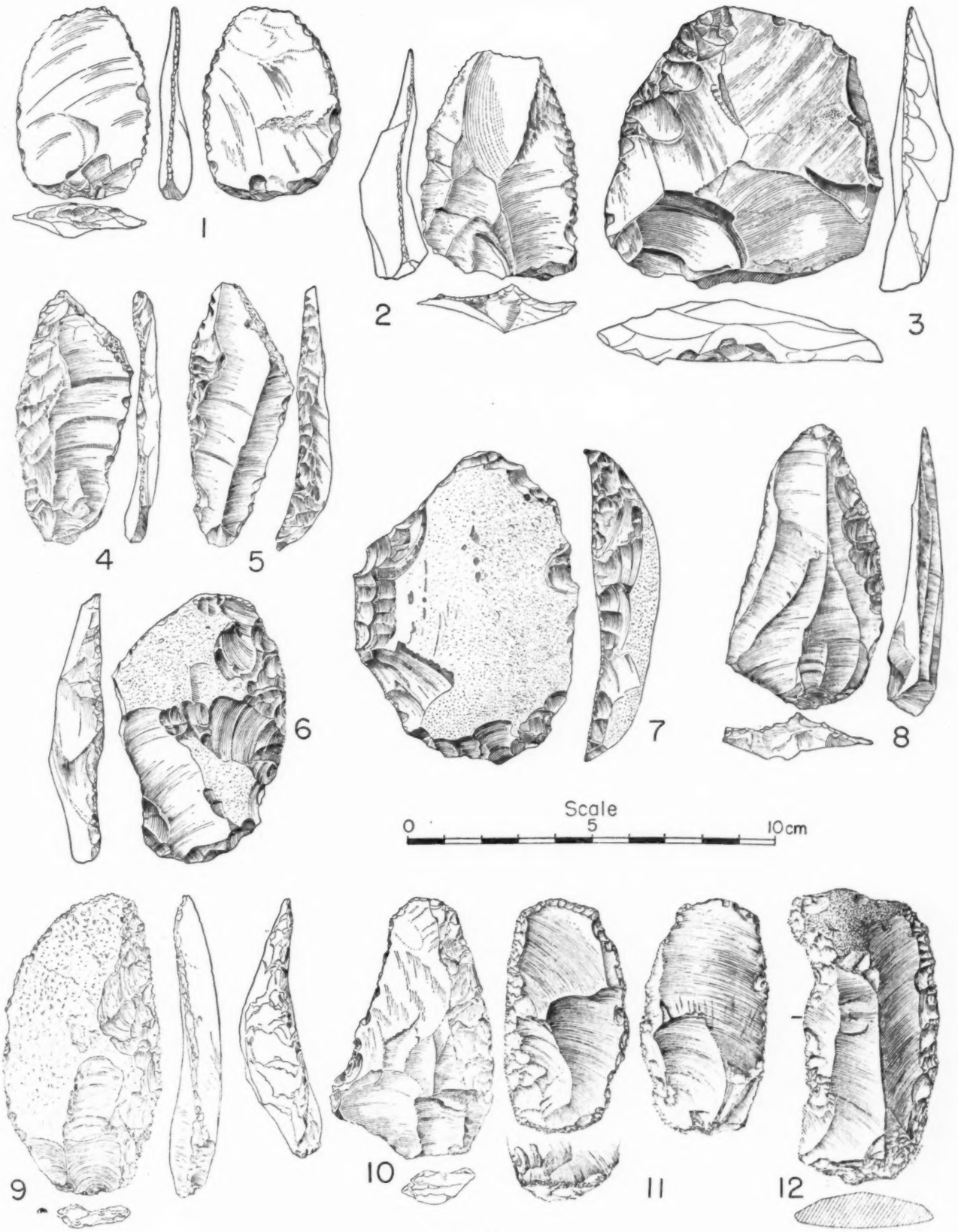


FIG. 64

FIG. 65. Side-scrapers.

1. A side-scraper of translucent flint, patinated an olive-color, and unrolled. It was made from a natural fragment. The upper surface has been prepared by heavy blows from along the edges. The right edge has been extensively retouched by step-flaking. The left edge has been blunted by fine indentations.

2. A side-scraper, patinated brown, and heavily rolled. It was fashioned from a flake-blade with a blunt right edge, which is still present. The upper surface shows several flake scars running directly inward from the right edge. The left edge was neatly retouched in two steps along its entire length.

3. A side-scraper of dark grey flint, patinated brown, and almost unrolled. It was probably made from a natural fragment produced by frost action. Both surfaces are covered by long flake scars, as well as by short scars which only reach the center. Retouching along one cutting edge is still distinguishable. The bulb of percussion has been removed from the lower surface by step-flaking toward the rear. It has previously been illustrated by Andree (1939).

4. A side-scraper of unrolled, olive-colored flint. It was made from a thick, slightly curved flake which retains some nodular cortex. The right edge shows over-all indentations made mainly on the lower surface. The left edge has been steeply retouched like a scraper at the distal end. Toward the rear flakes have been removed from the lower surface on the side opposite the retouched edge.

5. Leipzig-Lindenau. An oval side-scraper of rolled, olive-colored flint. It was made from a flat flake. All of the edges, except for the narrow striking-platform, exhibit short retouching executed from both surfaces. This specimen has previously been described by Etzold (1916–17).

6. A right-sided, straight-edged, side-scraper of flint, patinated an ochreous brown color and unrolled. It has been made from a previously prepared blade. The right edge has been sharpened by retouching executed in one or two steps. On the left edge is a concavity formed by two heavy and additional lighter blows on the lower surface. This probably served as a finger or thumb rest, or perhaps for hafting.

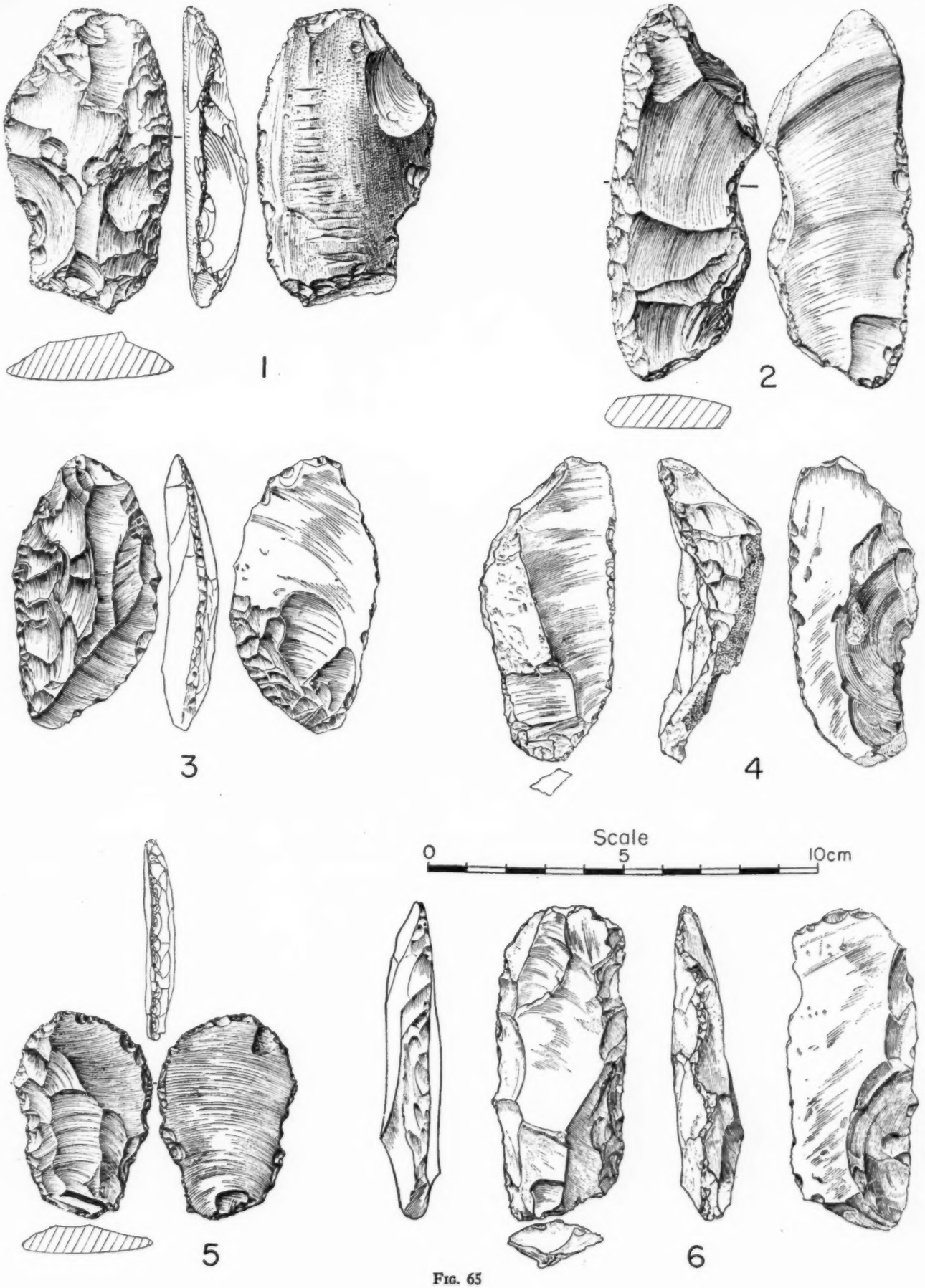


FIG. 65

FIG. 66. Side-scrapers.

1. A side-scraper of grey flint, patinated brown, and unrolled. It was made from a pointed, oval flake by very neat retouching of the right edge. The upper surface exhibits one main rib, which has been removed toward the rear by a thinning blow. The bulb of percussion has been carefully trimmed away from the lower surface. This specimen has previously been illustrated by Werth (1928: 411).

2. A right-sided, straight-edged side-scraper of unrolled, grey flint. It was made either from a cortical flake or from a natural fragment, as there are no percussion marks to be seen. The upper surface exhibits an area of nodular cortex. Subsequent retouching is limited to the right edge and was executed in two steps. There is a slight concavity opposite the retouched right edge, which has been formed on the lower surface by the removal of two flakes.

3. A pointed, right-sided, crescent-shaped, side-scraper of flint, patinated dark brown and unrolled. It has been made from a heavy flake-blade, which exhibits a cone and bulb of percussion, and a striking angle of 110°. The surface treatment was completed before the flake was detached from the core. Only the close, careful retouching of the right edge and the formation of a sharp point may be noted as subsequent work. On the lower surface, opposite the retouched right edge, two blows struck with a stone have formed a concavity.

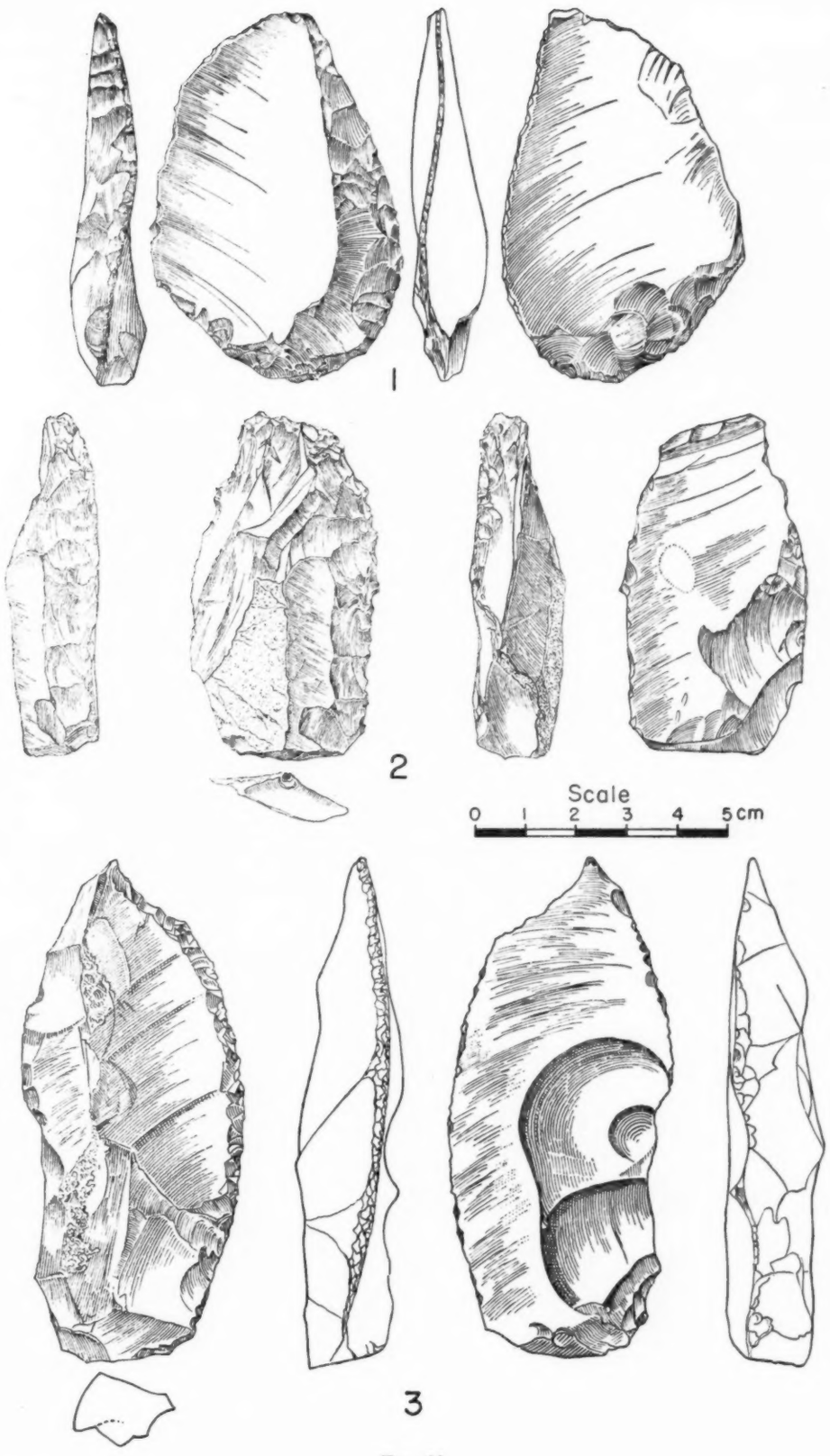


FIG. 66

FIG. 67. End-scrapers.

1. An end-scraper made on a core trimming flake of translucent, olive-green flint, unrolled, and only slightly patinated. This may be a natural fragment as there is no striking-platform or bulb. However, the steep edges have been extensively retouched. A few flakes have been detached from the distal edge in preparing it for the short, steep, scraper retouching which this edge displays. The original, slight curvature of the specimen made it particularly useful for the production of an end-scraper.

2. An end-scraper of grey flint, unrolled, and only slightly patinated. It is made from a thick flake-blade, has a large, plain striking-platform, a striking angle of 110°, and a slight *S*-curvature of the lower surface. The upper surface exhibits one main rib and a small area of nodular cortex on the distal end. The right edge shows fine indentations made from below at the rear, and from above toward the distal end which is itself heavily and steeply retouched.

3. A thick end-scraper of grey flint, slightly patinated and almost unrolled. It has a large, plain striking-platform, a prominent cone of percussion, a striking angle of 90°, and a strong *S*-curvature of the lower surface. The upper surface shows several flake scars. The thick distal end of the specimen exhibits steep retouching executed in several steps producing a sharp, curved edge as a result. This object is similar to an end-scraper found in the Holtemme gravel of equivalent age at Bahnhof Grossquenstedt (Hemprich, 1932). At Hundisburg, another site of the same age, a similar specimen was found which is now in the Landesanstalt für Volkheitskunde in Halle-an-der-Saale. In the Lower Acheulian of France heavy end-scrapers of this type also occur (Obermaier, 1908: 105, fig. 84), and Kelley (1937: fig. 3, no. 3) illustrates such an end-scraper from the Acheulian of St. Acheul (Mindel-Riss Interglacial).

4. An end-scraper of dark grey flint, slightly patinated, and unrolled. It is made from a core-trimming flake, the striking-platform of which has been removed by transverse blows, although there is still an indication of the bulb of percussion. The lower surface exhibits a strong curvature; the upper largely consists of cortex and is only slightly worked toward the rear. The distal end shows careful, sharp retouching of the edge.

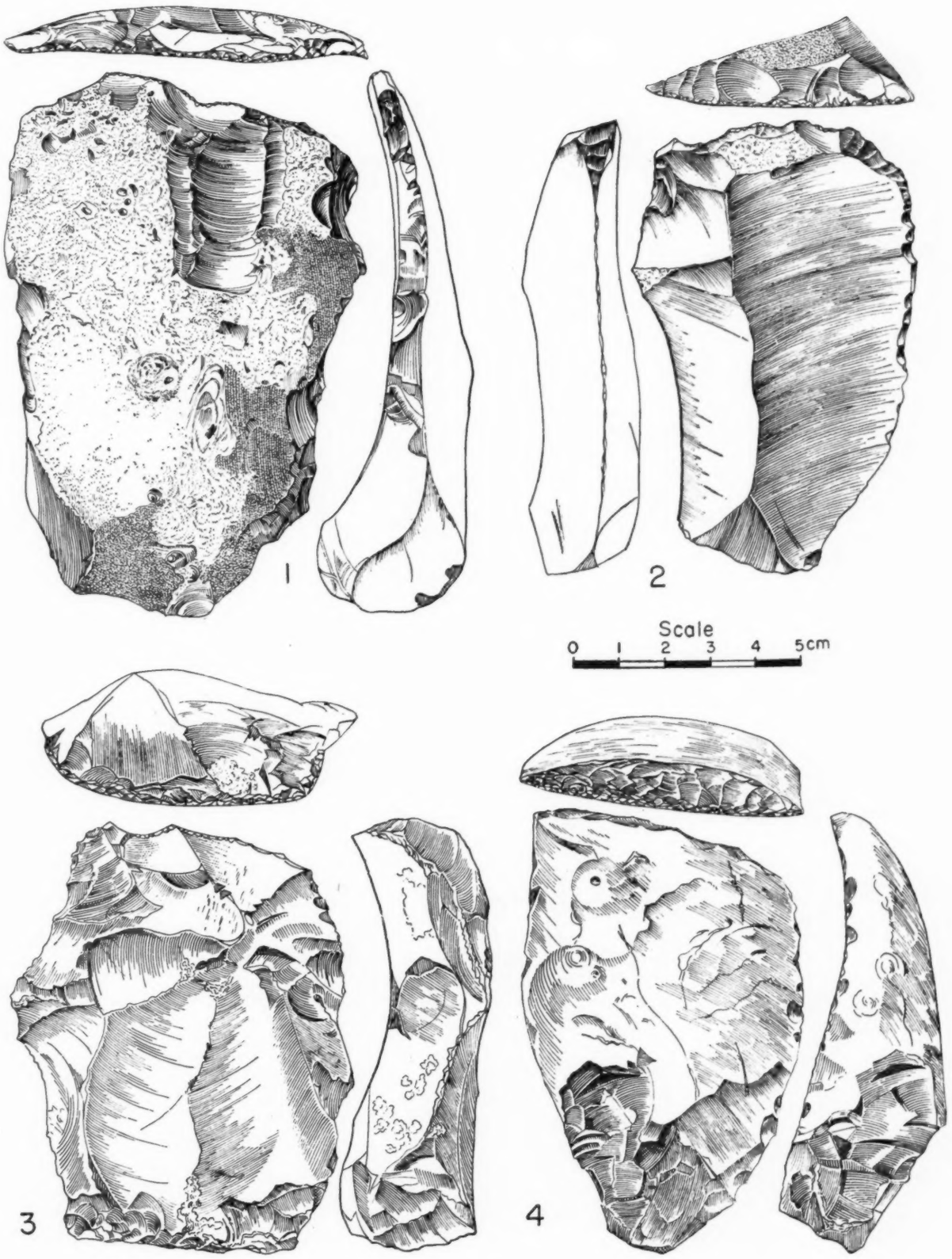


FIG. 67

FIG. 68. End-scrapers.

1. An end-scraper of mottled, black- and olive-colored flint, slightly patinated and almost unrolled. It was made from a flake with a tiny striking-platform. The upper surface is double-ribbed, and shows an area of nodular cortex on the right. The scraping edge is steeply retouched in a simple manner.

2. An end-scraper of grey flint, unrolled, and with a brownish patina. It was probably made from a natural fragment with a slight curvature. The upper surface shows one rib and some nodular cortex on the left distal end. The scraping edge exhibits simple, steep retouching.

3. A thick end-scraper, patinated grey-brown, and almost unrolled. It was made from a thick flake, the striking-platform of which has been removed by trimming blows aimed at the upper surface. Part of the bulb of percussion may still be seen, and there is a slight curvature on the lower surface. The upper surface exhibits one main rib, and is steeply retouched. This retouch extends in part to the rear of the specimen. The curved edge was sharpened by short blows.

4. An end-scraper of grey flint, slightly patinated, and almost unrolled. It was made from a flake with a pointed striking-platform, a short, thick bulb, and a pronounced *S*-curvature. Thus, a steep distal end was produced, which was sharpened by retouching. The upper surface shows one main rib. Both edges exhibit over-all indentations made from below.

5. An end-scraper of mottled, olive-colored flint, slightly patinated, and unrolled. The striking-platform is missing. The upper surface shows three facets, the one on the right consisting of nodular cortex. The distal edge is retouched quite steeply in two or three steps.

6. A simple, steep-ended scraper of grey flint, patinated brown, and almost unrolled. The striking-platform is missing. The lower surface of the specimen is flat. The scraping edge shows simple, coarse retouching.

7. An end-scraper of flint, patinated olive-brown, and unrolled. It was made from a flake-blade with a plain striking-platform, a short cone, and a slight curvature on the lower surface. The upper surface has one main rib. The right edge shows a few indentations. The distal edge exhibits fine, steep retouching.

8. An almond-shaped end-scraper of translucent, grey flint, slightly patinated, and almost unrolled. The striking-platform is on the pointed butt. The bulb of percussion has been trimmed away by the removal of an additional flake. The facets on the upper surface appear to be accidental. The right edge of the specimen shows a few indentations; the left shows steep edge retouching toward the distal end.

9. An end-scraper of translucent, grey flint, scarcely patinated, and unrolled. It was made from a flake or natural fragment which originally was larger but the striking-platform has been removed. The scraping edge was made by careful steep retouching executed in two steps.

10. A side-scraper of olive-colored, partly grey-black flint, patinated brown, and unrolled. The specimen apparently was made from a prepared flake, the striking-platform of which has been removed by subsequent trimming. The lower surface is slightly curved while the upper surface exhibits flake scars. The retouch along the right and left edges is less steep than is normally the case with scrapers.

11. An end-scraper made on a blade of banded, grey flint, slightly patinated, and unrolled. It was produced by the stone-on-stone technique, has a small, plain striking-platform, and a striking angle of 110°. The upper surface is flat and has two longitudinal ribs. Both edges show indentations made from above and below. The distal edge exhibits fine, steep retouching.

12. An end-scraper, patinated olive-brown, and slightly rolled. It is a thick flake with a prominent bulb of percussion and a slight curvature. The upper surface is single-ribbed and shows an area of nodular cortex on the left. The right side and distal portion of the upper surface exhibit flat retouching. The distal end of the right edge is especially well retouched, almost like a side-scraper. The distal extremity itself exhibits steep scraper retouching.

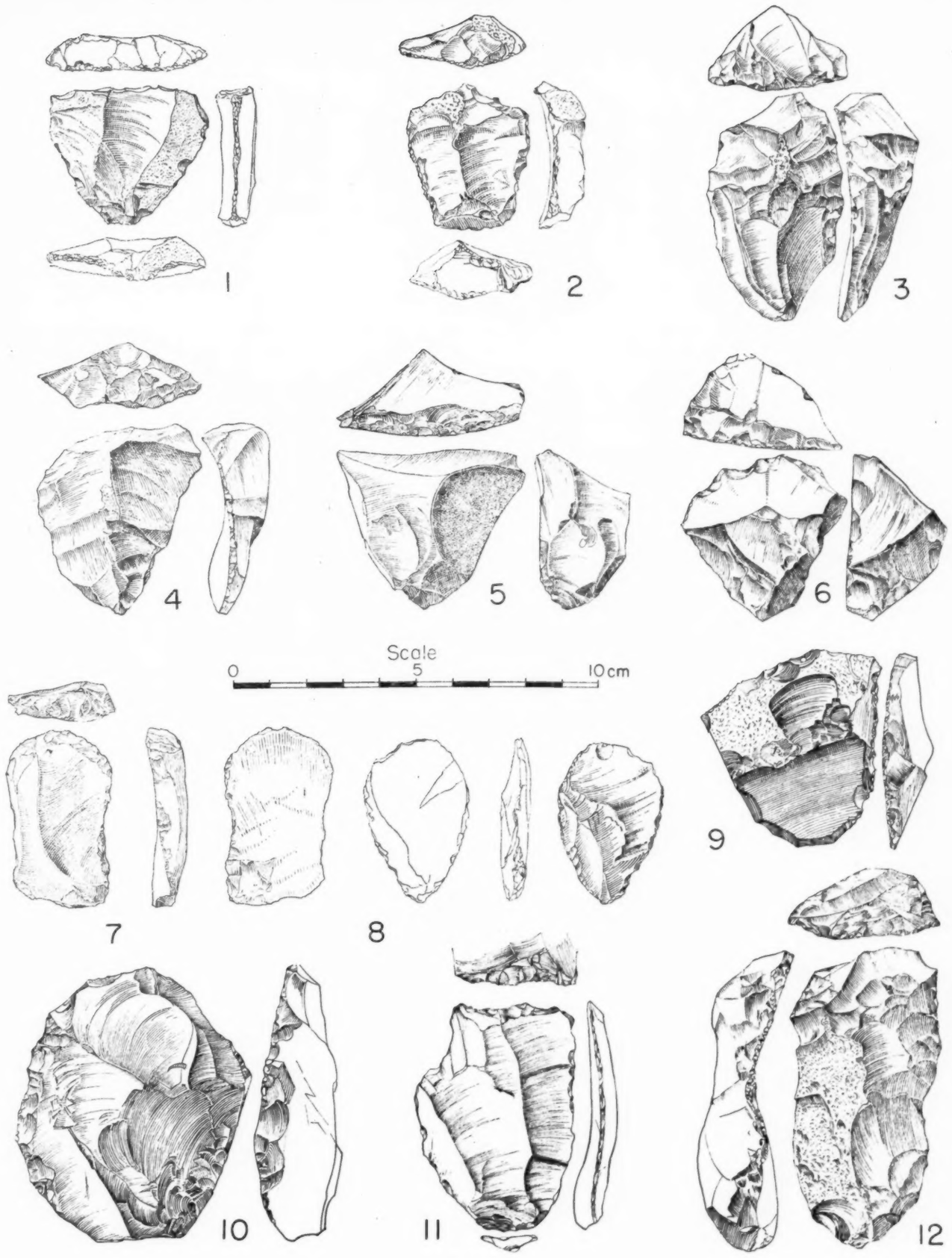


FIG. 68

FIG. 69. End-scrapers.

1. An indented scraper of banded flint, patinated brown, and unrolled. It was probably made on a natural fragment with a lower surface which was almost even. Both edges exhibit concavities produced by steep retouching. The retouch continues around the point, which shows an earlier projection on the upper surface. A very similar specimen has been described by Braune (1928: 84, no. 4).

2. A double-ended scraper of translucent, light grey flint, only slightly patinated, and unrolled. It was probably made from a flake-blade, the striking-platform of which has been trimmed away. The upper surface shows one main rib and some nodular cortex. The left edge exhibits coarse indentations. The right one shows steep retouching which forms a small curvature. The retouch creates scraping edges on both extremities. The rear extremity is curved.

3. A double-ended scraper of grey flint, slightly patinated, and unrolled. It was made from a flake-blade. The striking-platform and most of the bulb of percussion have been removed in the process of retouching the ends. The upper surface exhibits a forking main rib. Both edges show indentations made from above and below. The two extremities display steep retouching.

4. A scraper, patinated brown, and almost unrolled. It is a natural fragment with an almost even lower surface, which shows a few striations that are probably of glacial origin. There are also some parallel marks on one section of the upper surface. The left edge is steeply retouched; the right, only at the distal end. The specimen, though not typical, is similar to a keeled scraper.

5. A double-ended scraper of grey flint, slightly patinated, and unrolled. This specimen, which was found in a 2.00 m. exposure of pit *Md*, recalls Lower Palaeolithic forms. It was made from a flake, the striking-platform of which had been removed by trimming at the rear. The upper surface consists partly of nodular cortex. The left edge has been somewhat retouched on the lower surface. Both distal and rear extremities exhibit steep, simple retouching. This specimen has been illustrated previously by Andree (1939: fig. 61, no. 2).

6. A keeled scraper of grey flint, patinated a yellowish color, and rolled. It is a natural fragment with a sharp middle rib and a flat lower surface. Both edges exhibit steep scraper retouching.

7. A keeled scraper of translucent, grey flint, slightly patinated, and unrolled. It is a natural fragment with a steep midrib on the upper surface, and an almost flat lower one. Both edges exhibit steep scraper retouching. On the right edge is an artificially made indentation, on the basis of which the specimen may be classed as a concave scraper.

8. A concave scraper of grey flint, patinated olive-brown, and unrolled. The lower surface is single with no marks of percussion. The upper surface shows some simple trimming. Toward the distal extremity there is coarse, steep retouching forming a curvature.

9. A keeled scraper of mottled, light and dark grey flint, slightly patinated and unrolled. It was made from a nodular flake with an almost flat lower surface. The upper surface consists largely of nodular cortex, and has been trimmed from the edges, especially on the right. The left edge shows a prominent projection resulting from frost action. The distal end of the left edge and the entire right edge exhibit steep scraper retouching. The specimen has been previously described by Braune (1928).

10. A large scraper of dark grey flint, only slightly patinated, and unrolled. It was made from a thick flake which shows primary and secondary flaking over the upper surface. The right and left distal edges exhibit careful, steep retouching. The right edge is markedly convex owing to the *S*-curvature of the lower surface.

11. A keeled scraper of partly banded, unrolled, grey flint. The convex lower surface shows glacial striations parallel to the longitudinal axis of the specimen. The facets on the upper surface are largely artificially produced. Both edges show steep retouching. This specimen has been classified as a thick point (Andree, 1939: fig. 67, no. 1), but in the author's opinion this is incorrect.

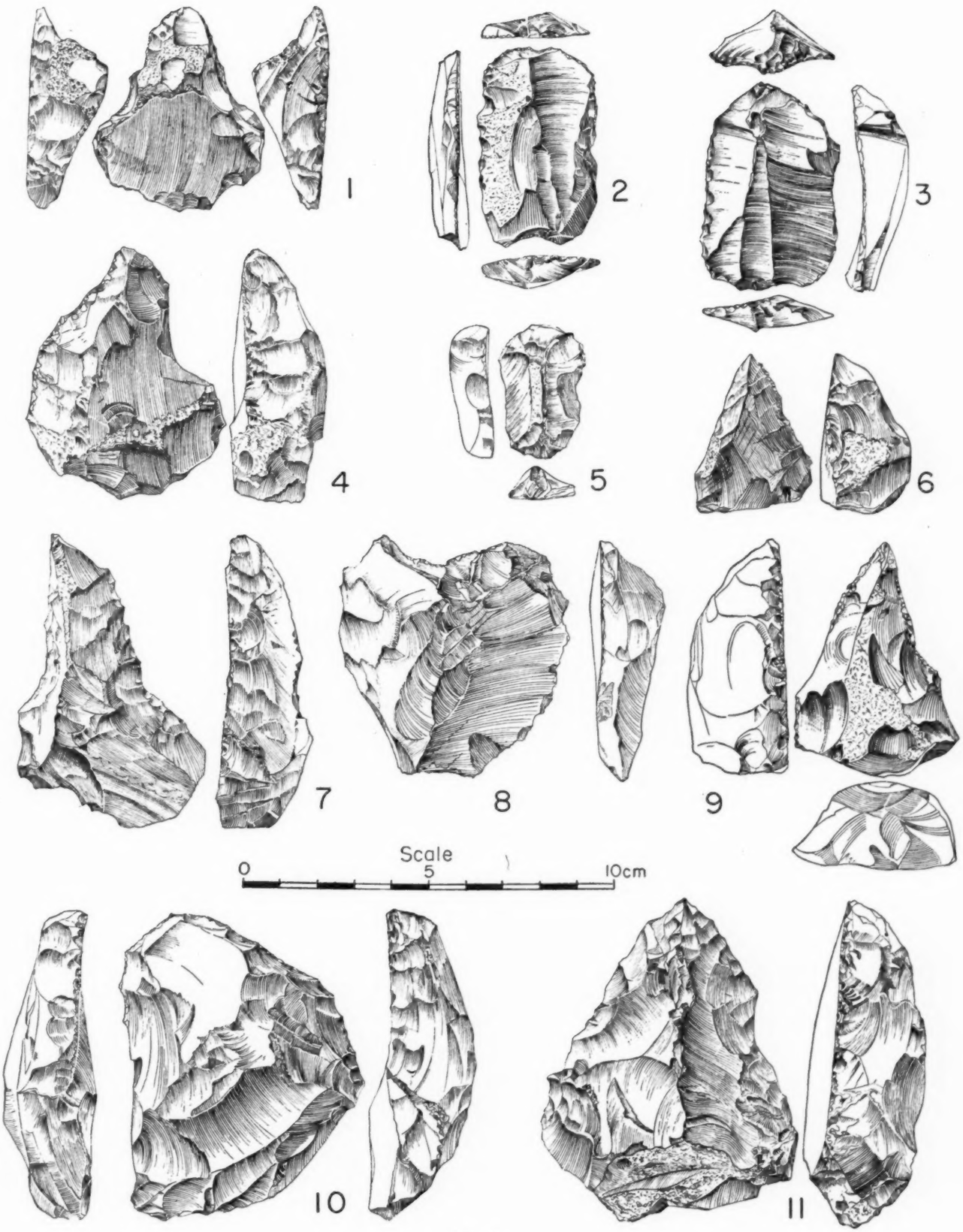


FIG. 69

FIG. 70. End-scrapers and awls.

1. A heavy end-scraper with an awl-like projection, patinated a yellow-grey color, and unrolled. It was made from a natural fragment of flint on which the prong has been fashioned by skillful trimming. The left edge exhibits steep retouching; the right shows shallow indentations toward the rear.

2. A heavy, oblique-ended, pointed scraper of variegated flint, unrolled, and patinated a yellow-grey color which is almost black near the cortex. The lower surface of the original fragment is marked by a broad, shallow flake-blade scar. The distal and side edges show curvatures made by steep retouching. The entire upper surface has been prepared.

3. A scraper of grey flint, patinated olive-brown, and unrolled. It was made from a broad flake with a thick bulb of percussion. The striking-platform has been removed by a trimming blow aimed at the upper surface. The right edge is partly unworked with a few retouching blows on the upper surface. There is also some nodular cortex on the right. The left edge has been retouched along the lower surface, producing a side-scraper. The transverse distal edge shows overall, steep retouching, with an indentation toward the right edge on the lower surface. As a result, the right edge has been fashioned into a crude awl point.

4. A straight awl of grey flint, rolled, with a shiny patina. It was made from a flake, has a striking-platform of nodular cortex, a prominent bulb, and a striking angle of 100°. The flat upper surface shows several flake scars. The rear and right edges are unworked. A "graver-blow" has been struck from the point. The left edge exhibits over-all simple retouching which forms a curvature toward the point.

5. A large scraper with an awl-like point, made from a fragment of an irregularly-formed flint nodule. The straight scraper edge and awl point have been carefully retouched, taking advantage of the natural shape. The thickened rear end of the specimen is useful for grasping. It is of grey flint, largely still covered by cortex. Beneath this cortex is a yellow patina several millimeters thick, which is similar to that of one of the specimens in Preservation Group 1. This specimen, however, probably does not belong in that group, since it is fresh and unrolled. It is possible that this is a special type of flint which is subject to the weathering process here described.

6. A large awl of light grey flint, only slightly patinated, and almost unrolled. It consists of a large, thick flake with a small striking-platform and a poorly developed bulb. On the pointed distal end a strong awl point was produced by retouching along the upper surface of the right edge and the lower surface of the left.

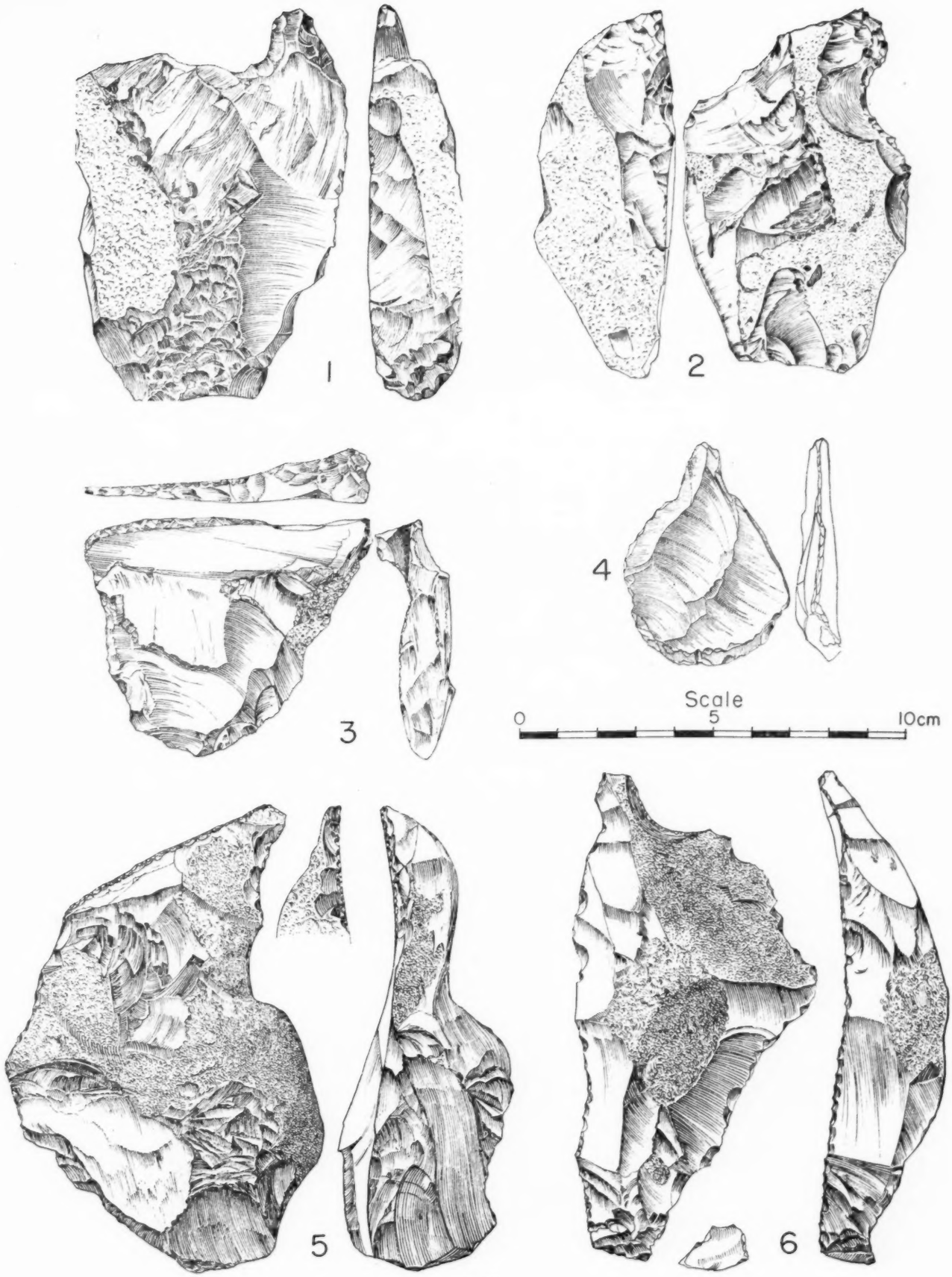


FIG. 70

FIG. 71. Awls and related types.

1. An awl of variegated grey flint, slightly rolled, and patinated. It was made from a flake-blade, has a plain striking-platform, and a striking angle of 115°. The left rear edge has been removed. Then additional stepped blows were struck toward the upper surface in order to reduce the thickness of the specimen, or possibly in order to provide an area for hafting. Both edges exhibit indentations, made mostly on the upper surface. A "graver-blow" has produced a prong-like point.

2. A straight awl of translucent, honey-colored flint, heavily rolled, and slightly patinated. It was made from a flake-blade which has been retouched at the distal end of the left edge along the upper surface, and the right edge along the lower surface.

3. A prong-like, side awl of translucent, honey-colored flint, slightly rolled, and patinated. It was made from a natural fragment. The right edge shows retouching along the lower surface. The awl point has been made by skillful blows aimed at the upper surface.

4. A scraper with two symmetrical awl points of grey-black flint, only slightly patinated, and unrolled. The flat lower surface shows no percussion marks. The upper surface consists partly of nodular cortex. The retouching is very neat, especially toward the rear and distal ends.

5. A straight awl of translucent, honey-colored flint, rolled and patinated. It was made from a natural fragment which still exhibits nodular cortex on the upper surface. A prong-like point has been produced as the result of retouched indentations on both edges toward their distal extremities.

6. A straight awl of light and dark grey flint, patinated brown, and unrolled. It was made from a flake, has a tiny striking-platform, and a small bulb of percussion. Both edges are quite blunt toward the rear. The left edge has been retouched very carefully at the distal end, producing a concavity adjoining the point.

7. A straight awl of grey flint, almost unrolled, and with an incipient white patina. It was made from a blade fragment with a slight curvature. The upper surface shows two blade scars, and cortex on the right side. The right edge exhibits indentations, made from above and below; the left shows indentations, made especially from below. Toward the distal end on the left edge an indentation has been made by heavy retouching, making the entire specimen into an awl-like implement.

8. An oblique awl of light grey flint, heavily rolled and patinated. It was made from an almond-shaped, cortical flake. Both edges show indentations. The left edge has a deep indentation toward the distal end, producing a prong-like point.

9. A straight awl of translucent, grey flint, slightly patinated, and unrolled. It was probably made from a natural fragment. The distal end of the left edge exhibits some retouching on the upper surface. The right edge has over-all retouching along the upper surface. A curvature has thus been produced with an awl point.

10. An awl of translucent, light brown flint, slightly patinated, and unrolled. It has a smooth lower surface with no percussion marks, and, therefore, it may be a natural fragment. All of the edges exhibit steep retouching. Both edges have indentations toward their distal extremities which have produced an awl point.

11. A scraper with an awl point made of grey flint, only slightly patinated, and unrolled. It was manufactured on a flake-blade, has a small striking-platform at a right angle to the long axis, and a thick bulb of percussion. The upper surface shows a few flake scars. The left edge exhibits over-all, crude indentations which form a slight curvature. The right edge is blunt at the rear, probably as the result of a blow struck after the detachment of the flake. At the distal end, the right edge shows retouching which also forms an indentation. The steep retouching on the right of the transverse distal edge, and the retouching of the right edge, together form an awl point.

12. An oblique awl of translucent, banded grey flint, patinated a honey color, and heavily rolled. It is made on a flake, has a plain striking-platform, a striking angle of 110°, and a pronounced curvature. The left edge is blunt; the right exhibits over-all indentations, and is retouched toward the distal end, near which an indentation has been made. The distal end of the left edge also exhibits a retouched indentation made on the lower surface, which results in a thick awl point.

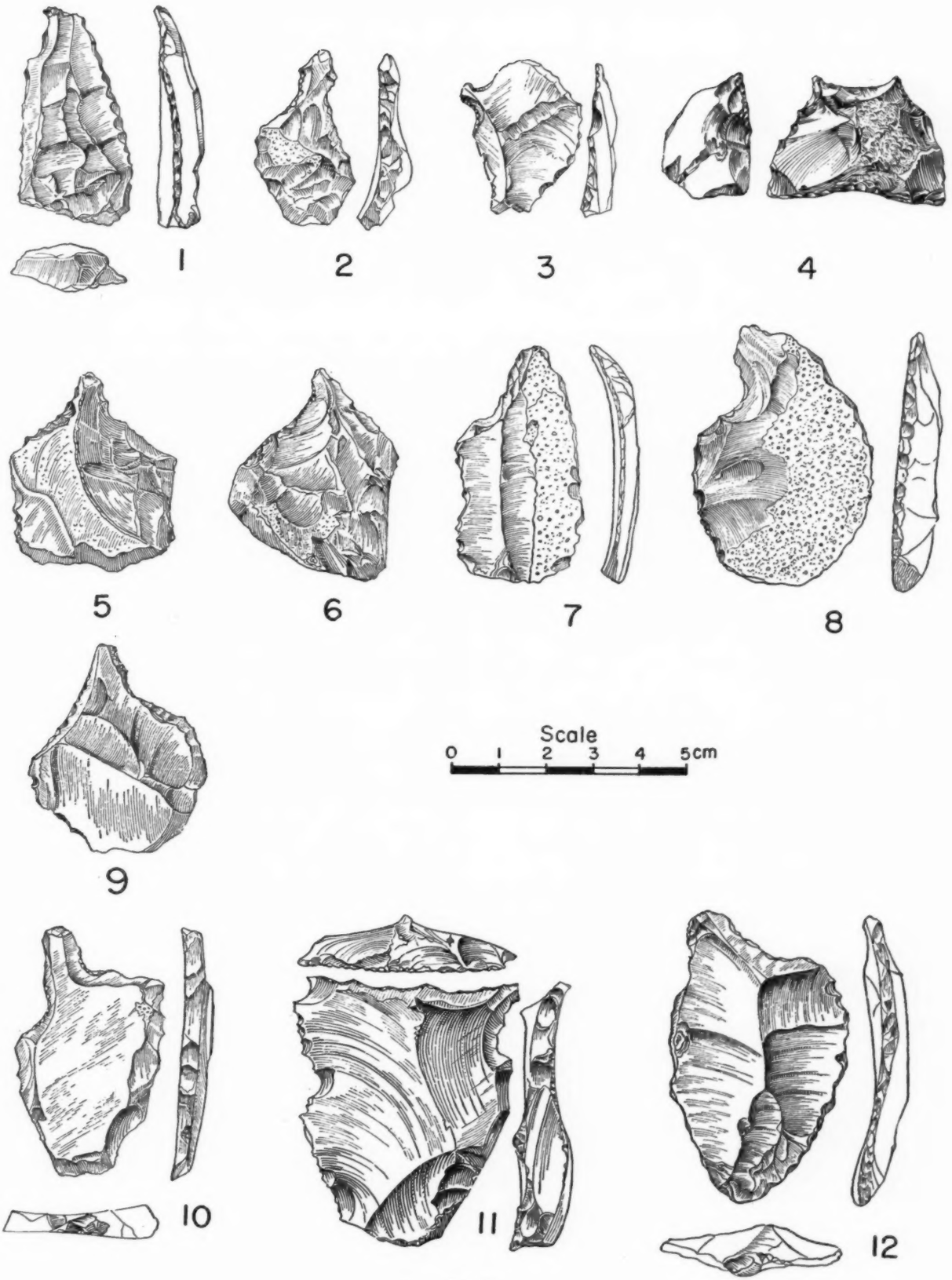


FIG. 71

FIG. 72. Bifaces.

1. A pointed, almond-shaped hand-axe of unrolled, dark grey and olive-colored flint. It has been made from a flake detached from a conveniently shaped nodule. The blow was struck with a hammerstone (as may be seen on the illustration to the right) to the rear of the small bulb of percussion. The preparation of the surfaces and edges has been done by both the stone-on-stone and bone billet techniques. Only a few blows were struck on the upper surface in order to sharpen the edges and to form the point. On the lower surface (with the bulb of percussion) one or two trimming procedures are noticeable. Neither edge is sharp nor straight, because of the carelessness of the flaking method. Pointed bifaces are found in all stages of the French Acheulian, most frequently after the Middle Acheulian (i.e., the second half of the Mindel-Riss Interglacial).

2. Zehmen. A fragment of a long, pointed biface of variegated grey-brown flint, slightly rolled, and with a shiny patina. It was probably made from a natural fragment, and still retains some nodular cortex. The specimen has been prepared by blows along the edges, and by blows parallel to the longitudinal axis, in the usual manner of a flake-blade core. Generally speaking, this specimen is crudely made. Nevertheless, the cutting edges are rather straight. The point is rounded. The rear part has been broken off in antiquity. It is impossible to reconstruct the original form of the specimen.

3. An oval biface of olive-colored flint, patinated brown, and almost unrolled. It was made from a nodular flake. The cortical surface has been trimmed mostly along the edge by short blows with a bone billet. Long flakes were detached from the blunt point. The opposite surface was trimmed by heavy blows from a bone billet. Many of the flake scars reach the center of the piece. There is occasional retouching along the edges. The shape of the specimen suggests that it belongs to the Middle Acheulian.

4. A pointed, almond-shaped biface of light and dark grey flint, slightly weathered, but with a colorless patina which is unrolled. It was made from a flint nodule, the cortex of which may still be seen on the blunt end. Both edges have been trimmed, first by heavy blows, and then by finer ones, especially toward the point. The edges are slightly wavy and sharp. The illustrated edge shows an *S*-curvature which may be due to the use of the same technique that produced the twisted, oval bifaces of the Middle Acheulian of Western Europe. This specimen was originally illustrated by Wiegers (1915) and has since been reproduced many times. Wiegers believes it to be an Acheulian shape, which is undoubtedly correct. Pointed types appear in France in the Early Acheulian, but in general they become more frequent after the middle of the Mindel-Riss Interglacial (i.e., beginning with the Middle Acheulian).

5. A disc-shaped biface of flint, patinated grey-brown and unrolled. It appears to have been struck from a core. Both edges have been trimmed by the bone billet technique, and they exhibit flake scars which often reach the center of the specimen. The wavy cutting edges have then been trimmed even further. This piece has been previously illustrated by Andree (1939: fig. 67, no. 4), but was incorrectly classified as a bifacially flaked and retouched round scraper.

6. A disc-like biface of flint, patinated light brown and unrolled. It was apparently made from a natural fragment in a simple manner. The edges were sharpened by blows from a hammerstone, and some fine flaking. The illustrated edge is straight; the other, zig-zagged. The method of preparation used in this specimen is similar to that of the Early Acheulian.

7. A fragment of a small biface of unrolled, dark grey and olive-colored flint. It was probably made from a nodular flake or from a natural fragment. Only one surface was worked and this exhibits heavy blows which detached flakes reaching to the middle of the specimen. There is occasional retouching of the edges. The opposite surface consists of the natural nodular cortex. The edges are rather straight. The rear part of the specimen was broken off in antiquity. Originally it was probably pointed and oval, similar to the specimen illustrated in figure 72, no. 1, which it resembles in all essential respects.

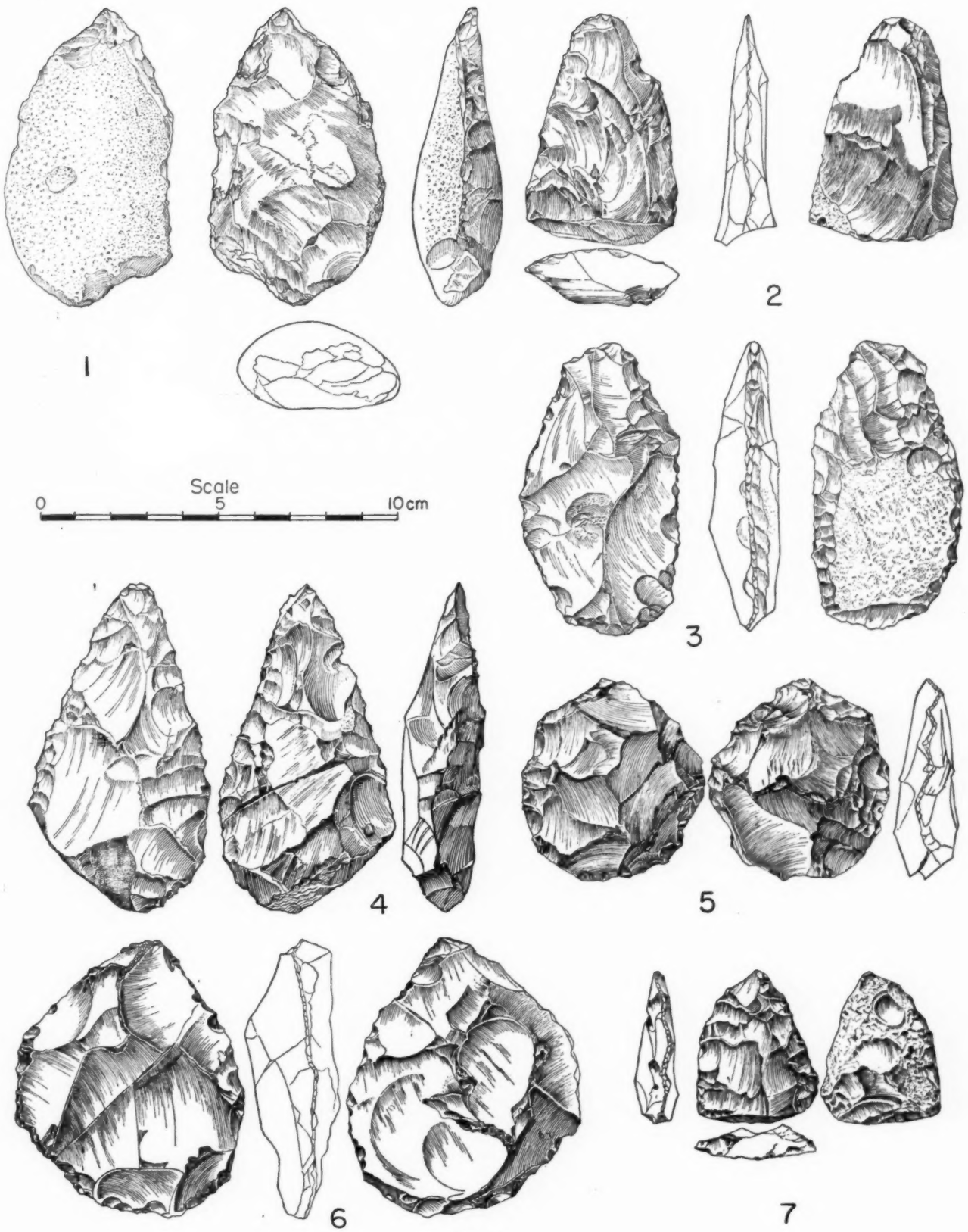


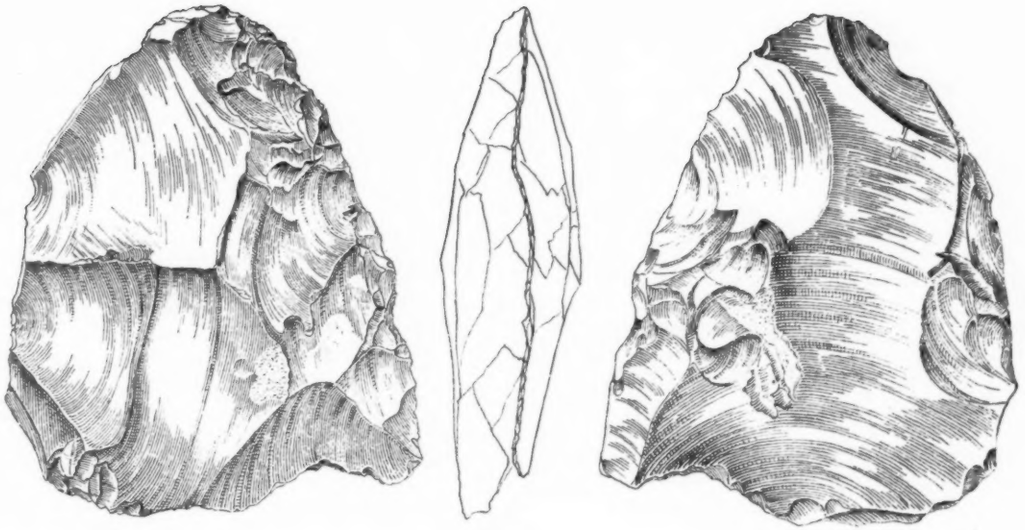
FIG. 72

FIG. 73. Bifaces.

1. A triangular biface, with a rounded point, of unrolled, olive-colored flint. The surface has been trimmed by blows from a hammerstone, in a manner similar to examples from the the Abbevillian. One cutting edge has been further sharpened by additional flaking. The specimen is intermediate in form between a biface and a retouched side-scraper.

2. An oval biface of dark grey and olive-colored flint, partly patinated brown, and unrolled. It was probably made from an artificially made flake with nodular cortex. The bulb of percussion has been removed as the result of trimming along the edges. The cortical surface has been sharpened along one edge, mostly by blows executed in a single step, but sometimes with subsequent work. On the lower surface the flaking usually reaches to the center of the specimen. The flaking was so heavy that in part the cutting edge became very wavy, especially as it was not retouched. Owing to the shape, the specimen corresponds particularly well with the beautiful, oval bifaces, called *limandes* or *Seezungen* (soles) of the Middle Acheulian in France.

3. A biface of light and dark grey flint, patinated light brown and almost unrolled. It was probably made either from a large flake or from the remainder of a rectangular blade core. In any case, the surface in the illustration on the left shows that the maker was more skilled in producing blades than in the production of bifaces. This surface exhibits a few flake-blade scars detached when flake-blades were struck from distal and rear ends. Additional shorter flakes were removed from each of these ends as well as from the left edge. The opposite surface exhibits fewer and shallower flake scars and some simple retouching toward the right edge. The right edge, as the side view shows, is rather straight. The left edge, however, lacks any such retouching; it is two centimeters thick and blunt.



Scale
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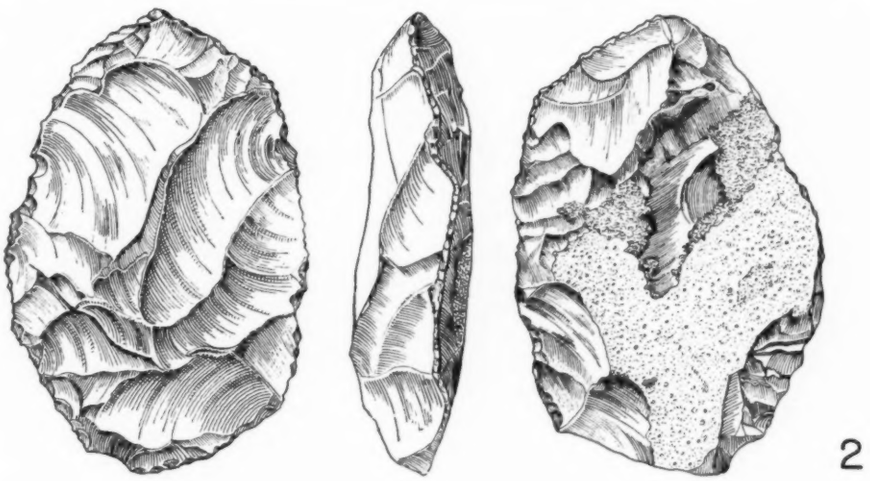
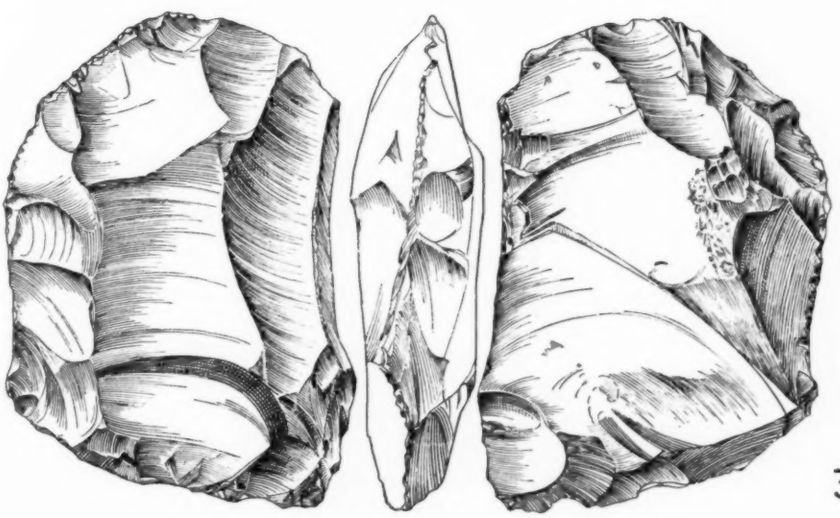


2



3

FIG. 73

FIG. 74. Bifaces.

1. An irregular biface of unrolled dark grey and olive-colored flint. It is a nodular fragment from which blade-like flakes have been detached across one whole surface. A few places along the edges have received additional flaking, which is rather straight, as in the example illustrated. The opposite edge is quite irregular, however, owing to the presence of nodular cortex.

2. An oval biface of unrolled, variegated light and dark grey flint. It was probably made from a natural fragment. The surface has been trimmed by blows on a bone billet. The shallow flake scars often reach to the middle of the specimen. In addition, simple flaking along the generally straight edges may be recognized. Nodular cortex may be noted on one area.

3. A biface of grey flint, patinated an ochreous brown color, and unrolled. It has been completely worked on both surfaces. One surface (as illustrated on the right) is more curved than the other. The upper surface has been trimmed in a stepped manner. The left edge is trimmed more finely than the one on the right. The cutting edges are nearly straight but show some slight undulations. The rear part of the specimen was broken off in antiquity, probably by use. The distal end was fractured after the specimen became embedded in the gravel, possibly as the result of frost, for this cleavage plane shows less patina than do the other surfaces. It is not known whether this end was blunt or pointed. In spite of its poor preservation, however, this biface shows a close similarity to the Acheulian specimen already noted (fig. 72, no. 4); it has been previously described by Jacob-Friesen (1914: fig. 13).

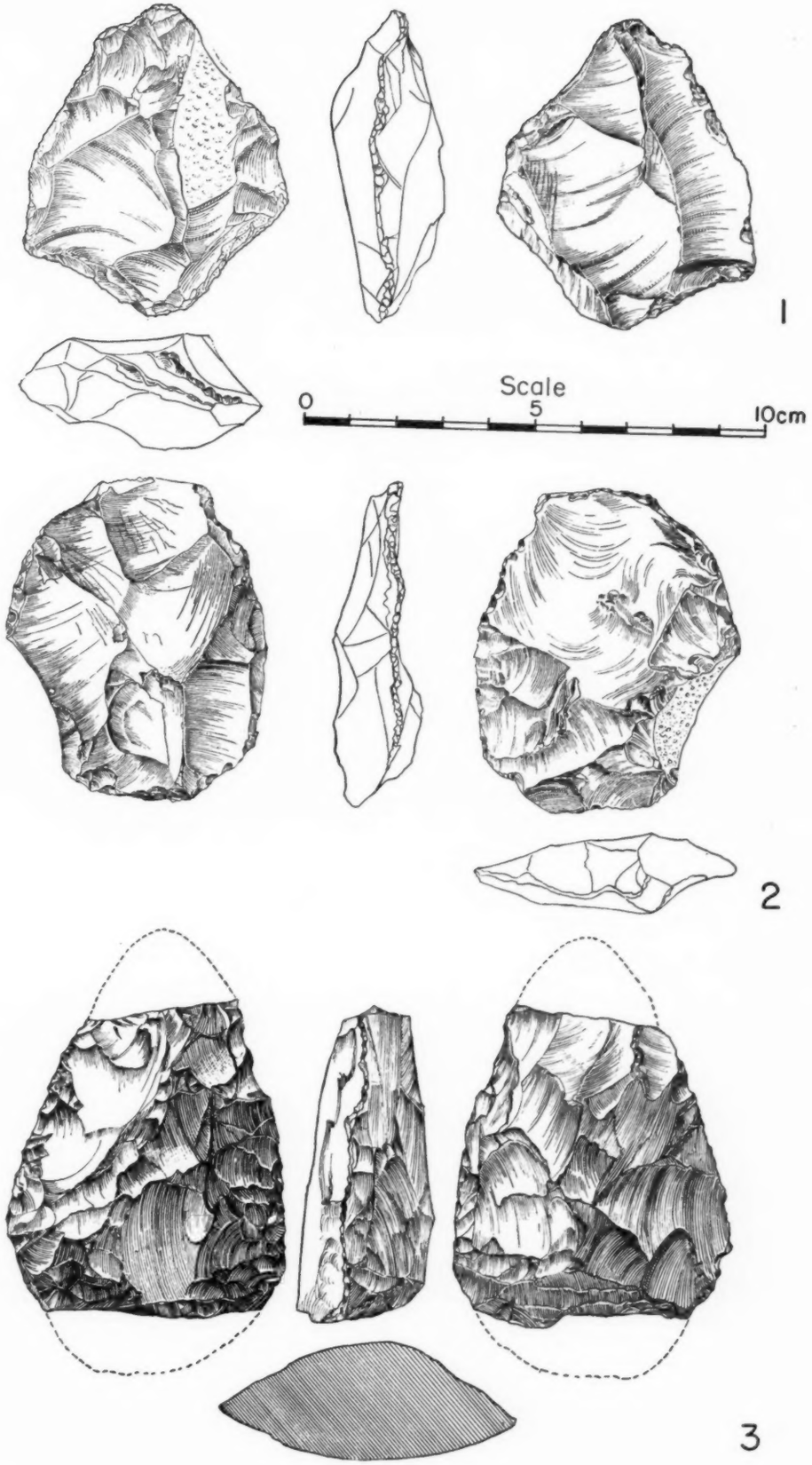


FIG. 74

FIG. 75. Bifaces.

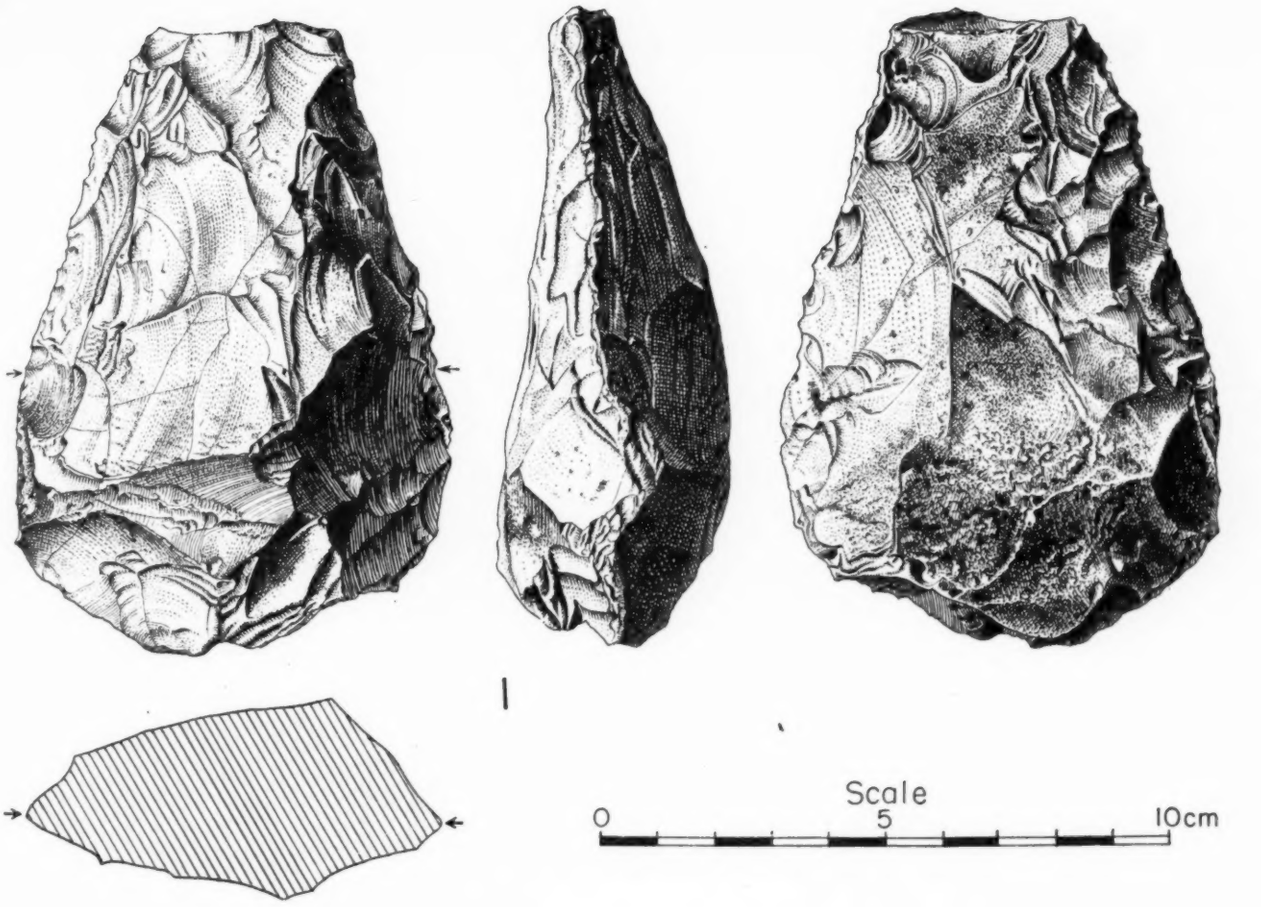
1. A large, almond-shaped biface of grey flint, heavily patinated light brown and slightly rolled. The lower surface shows a black area, probably due to a manganese stain. The specimen was made from a large, natural nodular fragment. The lower surface, shown in the illustration at the right, is thickened toward the rear by the presence of a rough, possibly crystalline, quality which is found in certain types of flint. The maker did not succeed in removing this area, with the result that the rear end remained thick and blunt, and in part curved, as may be seen in the illustration on the right, and in the side view. The upper surface, illustrated on the left, is more strongly curved, probably owing to the original shape of the fragment. This surface shows the results of a few strong blows struck from both cutting edges and the rear toward the ridge in the center. The subsequent light flaking, especially toward the upper surface, produced rather straight cutting edges. The left edge (illustrated on the left, and also in the side view) is straight and sharp. The right is blunt at the distal end as though struck by a "graver blow." Whether or not this was actually the case cannot be determined, because of the loss of the point in antiquity, probably as the result of use. This biface shows similarities to the smaller one shown in figure 72, no. 4, and, although smaller and finer, to the large one in figure 75, no. 2. Both have been flaked asymmetrically from nodular fragments, probably selected because of their natural shapes. Both show an extensive development of the left cutting edge, a blunt rear end, and points broken off perhaps as the result of the same method of use. In addition, the blunting of the right cutting edge of this specimen corresponds perhaps to the same intentional action which broke the right distal edges of the *coup-de-poings* from Zehmen. This specimen was found in Pit *Md* only after the completion of the text of this monograph, and is, therefore, not mentioned in it. However, it seemed appropriate to include it as a figure in view of the very small number of bifaces from Leipzig sites. We are particularly grateful to Professor Jacob-Friesen who had the drawing made.

2. Zehmen. A large biface of olive-colored flint, patinated an ochreous brown, and unrolled. This true *coup-de-poing* was made from an appropriately shaped fragment of a flint nodule. Thus, it has an asymmetrical outline with a strongly curved upper surface, which corresponds to the upper surface of the original nodule, as may be deduced by the fact that there is an area of nodular cortex near the butt end (illustration on the left). The lower surface is much flatter. The rear end is broken off steeply and is quite blunt. The distal end is rounded rather than pointed. The right distal corner has been broken off in antiquity.

The upper surface was prepared by the detachment of broad flakes, most of the scars of which reach the center of the piece. Toward the distal end the flakes become finer until they are replaced by working along the edges. The lower surface is prepared in the same manner, except that it lacks the edge preparation toward the rear. The left edge, shown in the illustration, is quite straight; the right one, on the other hand, is irregular.

This specimen, which weighs 600 grams, may be correctly described as a *coup-de-poing,* as it fits into the hand and has a shape characteristic of these implements. The broken point may indicate that it was used for percussion, or for prying or lifting. The sharpening along the left edge shows that it was also used for cutting.

Coup-de-poings of similar flat-iron shape appear as isolated specimens in the Early and Middle, and even the Late, Acheulian of Western Europe. This particular specimen was originally described by Grahmann (1938*b*).



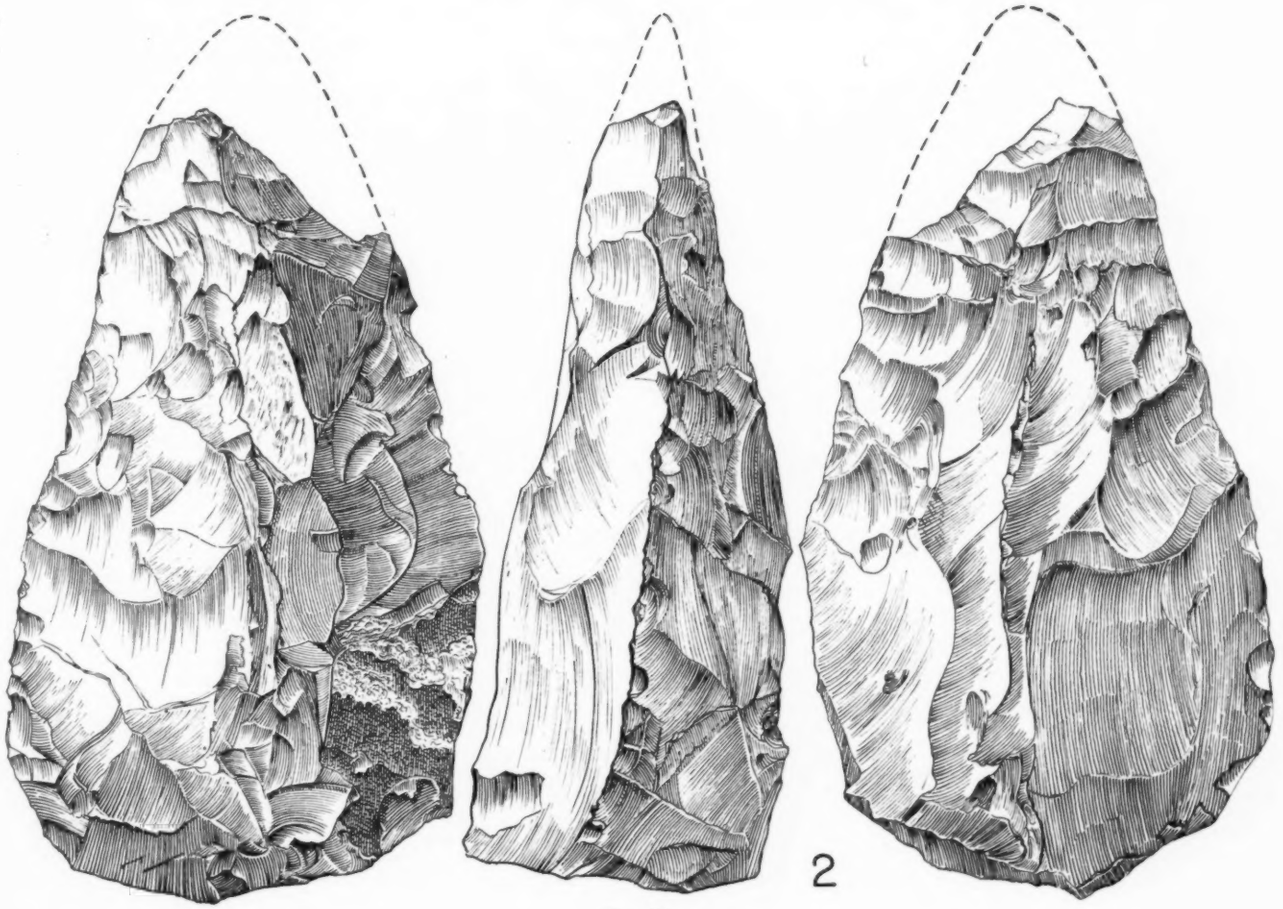


FIG. 75

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